

Journal of the Society of Chemical Industry.

No. 10, Vol. XXXIV.

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Official Notice.

ANNUAL GENERAL MEETING, 1915.

In accordance with the provisions of By-law 64, notice is hereby given that the Annual General Meeting will be held at the Municipal School of Technology, Manchester, commencing at 10.30 a.m. on Wednesday, July 14th, 1915.

PROVISIONAL ARRANGEMENTS.

Wednesday, July 14th, 1915.

Morning: Annual General Meeting and Address from the President, Prof. G. G. Henderson, D.Sc.

Afternoon: "Co-partnership in Chemical Works." Sir Wm. H. Lever, Bart.

Evening: Annual Dinner.

Thursday, July 15, 1915.

Morning: "Research and Chemical Industry." Mr. M. O. Forster, F.R.S., and Dr. Chas. C. Carpenter.

Afternoon: "Legislation and its Effect on Chemical Industry." Prof. H. E. Armstrong, F.R.S.

Evening: "Chemical Engineering." Dr. G. T. Bellby, F.R.S.

Evening: Visit to the University Laboratories. Demonstrations by Sir Ernest Rutherford, F.R.S., Prof. W. J. Pope, F.R.S., and Prof. Harold Dixon, F.R.S.

Friday, July 16th, 1915.

Morning: "Economic Utilisation of Coal and the Production of Cheap Power." Mr. Walter F. Reid.

Afternoon: Visit to Works (Trafford Park Estates).

Evening: Social Meeting.

In accordance with the provisions of By-law 24, those members whose names are printed in *italics* in the List of Council will retire from their respective offices at the forthcoming Annual Meeting.

Dr. C. C. Carpenter has been nominated to the office of President under By-law 20; Prof. G. G. Henderson has been nominated a Vice-President under By-law 20; Prof. E. C. C. Baly, F.R.S., Mr. R. H. Clayton, and Mr. Julius Hübner have been nominated Vice-Presidents under By-law 21, and Mr. Thos. Tyrer and Dr. R. Messel, F.R.S., have been re-appointed Hon. Treasurer and Hon. Foreign Secretary respectively.

Dr. E. F. Armstrong, Prof. H. E. Armstrong, F.R.S., Prof. W. H. E. Hodgkinson, and Mr. Walter F. Reid have been nominated under By-law 25 to fill four vacancies among the Ordinary Members of Council. No ballot will be required.

CHARLES G. CRESSWELL,
Secretary.

London Section.

Meeting held at Burlington House on Monday, June 8th, 1914.

PROF. W. R. HODGKINSON IN THE CHAIR.

THE DICKSON CENTRIFUGE SYSTEM OF SEWAGE TREATMENT.

BY E. HOWARD TRIFT, PH.D.

The subject of sewage disposal is of such great importance that no apology is needed in describing an original and ingenious system which promises to be more efficient and at least as economical as any at present in

vogue. Even if the ultimate results do not correspond fully with the hopes and anticipations which are now entertained in influential quarters, few will deny, when they have studied the process, that it affords the elements of a real advance on existing methods and incidentally presents some novel points of scientific interest. The scheme has been successfully translated into practice at Dublin and at Winnipeg. The corporation of the former city has entered into a 25-year contract for the treatment of the whole of its sludge by the Dickson process, and at Winnipeg a small complete plant has been in operation for some time past.

The Dickson process.

Some years ago Mr. Alexander Dickson, of Dublin, noticed that solid matter could frequently be seen floating on the Liffey below the point where the effluent from Messrs. Guinness' brewery enters it, but above that spot no such floating matter was visible. He framed the hypothesis that the flotation might in some way be causally connected with the yeast present in the effluent. This idea was tested by treating sewage and sewage sludge with live brewer's yeast in an experimental plant, and the results confirmed the hypothesis. It was further established that the most favourable temperature was between 90° and 96° F., and also that only a very small proportion of yeast was needed. The separated sludge was found to contain about 80% of water, against 90% normally present in the raw material. A typical analysis of the materials would show:—

	Raw sludge.	Top fermented layer.	Effluent.
Total solids	9-11	18-22	6-7
Organic and volatile	5-6	10-12	3-4
Ash	4-5	8-10	2-3
Nitrogen	0.3-0.4	0.6-0.8	0.01-0.02
Nitrogen of dry material	3-4	3-4	

Thus by treating with yeast, about one-half of the water present in the raw sludge is eliminated, and this fraction is found to be approximately constant, whatever the original water-content of the sludge may be.

The removal of the rest of the water proved to be the most formidable of all the obstacles. Sewage sludges that are sold, or given away, for manurial purposes either contain such a large percentage of moisture that the cost of transport is prohibitive, or they have been dried in such a manner that much, if not most, of the original nitrogenous content has been burnt out. Prolonged air-drying is resorted to in some places, but this involves a large storage space, and also a loss of nitrogen. After many vain efforts, success was attained by the ingenious modification of a plant that is used in France for pulverising and drying coal in the manufacture of briquettes. With the aid of this apparatus, practically all the moisture present can be removed, although in practice this is unnecessary and inadvisable.

The maximum temperature to which the treated sludge is exposed is 450° F., and analyses made before and after drying show that not more than 0.2% of nitrogen is lost in the operation.

The Dublin sewage plant.

The Dublin sewage, amounting to a daily average of 13 million gallons, is conveyed through an 8 ft. main sewer for a length of two miles to the pumping station where, after passing through a screen chamber, it is raised 23 ft., and is then allowed to flow into the sedimentation tanks. There are eighteen of these, each measuring 94 ft. square, and their cost was no less than £300,000, exclusive of the value of the land. The total cost of all the works was £508,000. No chemicals are used, and after the

sedimentation has taken place, the effluent flows over concrete sills into a channel, from which it is discharged into the estuary of the Liffey. The effluent is not a good one; it will support fish life for a very short time, but its discharge into the estuary is unattended by any apparent harm owing to the great degree of dilution it undergoes. The sludge is swept into a second culvert, thence into a sump, pumped to a high-level tank, and finally flows into a sludge steamer, which cost some £12,000 to build and entails a further £3000 per annum for upkeep. It makes on the average about three voyages a week and dumps some 1200 tons of sludge into the bay in the same period.

A pipe from the high-level tank takes the sludge into the new works which, although occupying less than one acre of ground, are built on such a scale as to cope with the whole of the Dublin sludge. At the present time a portion only of the sludge is being treated, owing to delay in delivery of some additional drying plant. The process has been worked intermittently for several years, and in November, 1913, on the initiative of Mr. J. D. Watson, the Birmingham Drainage Board sent Mr. L. F. Mountfort, A.M.I.C.E., to make a thorough investigation and a continuous, night and day, test for 14 days. The result of this examination was to substantiate fully the claims made by the management, both as regards efficiency and costs.

The Dickson plant.

The sludge is conveyed along an open trough to a small screen where solid matter, which might block the pumps, is removed. About 0.5% of yeast, mixed with water, and about 3% of already fermented sludge are added, and the mixture is pumped into a "heater," consisting of a number of pipes heated by hot air, so that it attains a temperature of 94° F. From this point it flows into a distributing trough which feeds the fermenting troughs. These are eleven in number, each measures 50 by 4 ft. and has a capacity of 3000 gallons or 15 tons. They are made of concrete, and beneath them are hot-air ducts which maintain the contents of the troughs at about 94° F.

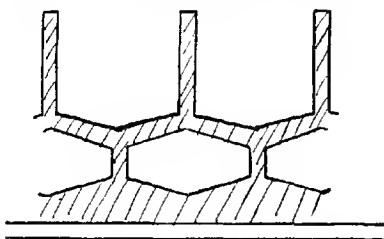


FIG. 1A.—Section of fermentation troughs showing hot-air ducts.

In 24 hours or less the action is completed, the solids have separated out and come to the surface, leaving the more liquid portion beneath. The former are run off through sluice valves into a receiving trough, which, like the distributing trough at the other end, is placed at right angles to the fermentation troughs. The effluent passes out of the troughs through vertical perforated pipes, the perforations being of such a size that no solid matter can get through. The amount of suspended matter in this effluent is small, but, in the case of inland towns, it would have to be further purified by the centrifuge process before final discharge.

From the receiver-trough the separated sludge is pumped through a pipe (h) into a patent distributor (a) at the top of the "dryer." (Fig. 1.) This consists of a vertical, cylindrical tower fitted together in sections, and containing a number of horizontal perforated platforms (g, f) which are alternately fixed and rotating upon a central shaft (d). On the under-side of each rotating platform is a scraper (h) which moves over the surface of the fixed platform below it, and acts as a rake to subdivide the sludge before it falls through the perforations (e). At the

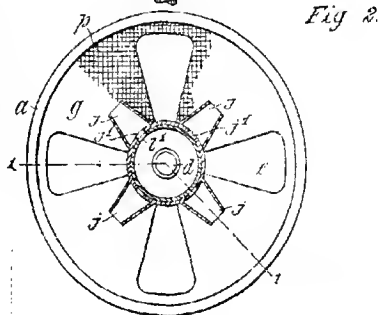
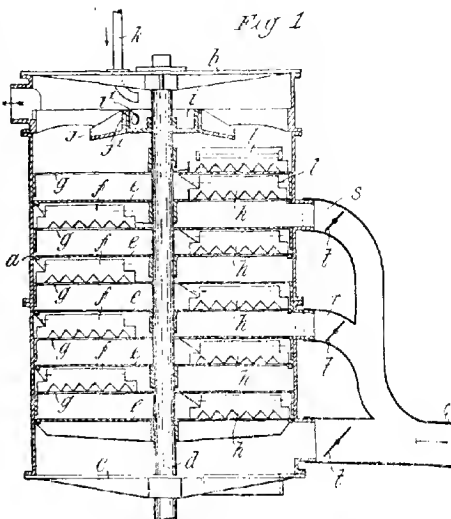


Fig. 3

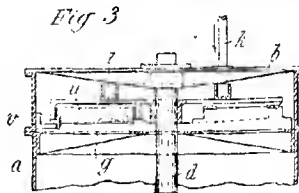
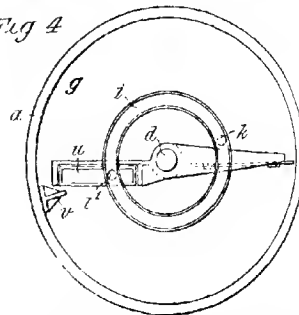
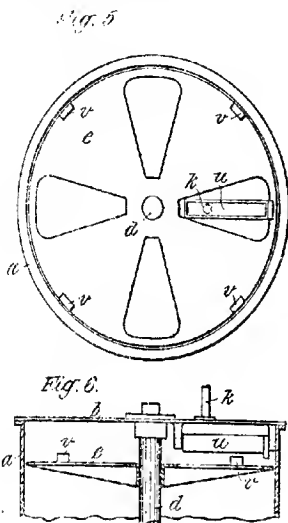


Fig. 4



same time hot air, at about 450° F., is admitted at the bottom (and only at the bottom, in the latest type of the machine), and passes upwards through the apparatus.

After emerging at the top, it is further utilised for maintaining the temperature of the heater and of the fermentation troughs, and it finally passes back into the combustion chamber of the furnace from which it originally



issued. It is found that 1 lb. of average coal is required for every lb. of dried sludge produced, but it is anticipated that the most recent improvements will increase this ratio by 20–25%. The dried sludge falls out at the base of the apparatus into a patent disintegrator, consisting of revolving paddles working in a draft of hot air. In this way the process of desiccation and pulverisation is completed.

Theory of the action of the yeast.

By the expression "yeast fermentation" it might be implied that the flotation of the solids in the sludge is due to the action of yeast as a fermentative agent, but investigation has shown that:—

- (1) Killed yeast is just as effective as live yeast.
- (2) After introduction into the sludge, the yeast cells rapidly degenerate and before long completely disappear.
- (3) The action does not take place if the sludge be previously sterilised.

The conclusions from these observations are: that the action is due to the anaerobic micro-organisms which feed on the yeast; and that the levitation of the solids is caused by the escaping gases. These gases have not been analysed, but there is no reason to doubt that they contain carbon dioxide, methane, and hydrogen, the normal gaseous products of the anaerobic fermentation of cellulose, as the bacteria found in the troughs have been identified as cellulose and sugar fermenting organisms. Not only dead yeast, but such substances as starch and dextrose produce the same result, but more slowly. The best and quickest agent is brewer's yeast at 95° F. This is all that has been ascertained so far as regards the action of the yeast. It is, however, quite within the bounds of probability that the enzymes in the yeast may exert their specific functions, as they would withstand the temperature of the sludge. The differences between the Dickson product and ordinary septic tank sludges seem to point to the existence of some action or actions above and beyond those involved in ordinary anaerobic fermentation.

The fertiliser.

As the commercial success of the Dickson process will depend to a considerable extent upon the value of the

recovered sludge, it is interesting to inquire how its composition and properties bear resemblance to those of ordinary sewage sludges. The findings of the Royal Commission on sewage disposal on the question of the manurial value of sewage sludge were none too optimistic. It is admitted on all hands that the potential value of the constituents is great, and when we consider the enormous quantity of material that would be available, very great, yet although their application to the soil has been attended with some benefit, the results have been much less favourable than *a priori* judgments would indicate. It was unfortunate that so many of the sludges investigated by the Royal Commission contained trade waste of various kinds. The effects of small amounts of certain mineral salts, etc., upon plant life have been shown in some cases to be very great, hence in an investigation of such a nature, it would have been better to have confined the preliminary work to the examination of the manurial effects of plain domestic sludge and so in the first instance to have reduced the problem to its simplest form: for even the simplest form in this case is a very complicated one.

At the present time two fertilisers are being produced and marketed in Dublin: the plain dried sludge, called "Manurito," and the same material mixed with phosphates and kainit, termed "Compound Manurito." Owing to the exposure to heat in the "drier," the product is entirely free from live seeds, which are usually present in other dried sludges and which, when put on to the soil, germinate and produce an undesirable flora. For the same reason it is practically free from microbial life, bacteriological examination having disclosed merely the presence of one or two heat-resisting micro-organisms. "Manurito" is in such a fine state of division that it readily mixes with the soil and it could be applied with the seeds in the drill. When moist the smell may be described as acute, but when dry it is nearly odourless. It is highly probable that the knowledge of the chemical composition of such a natural fertiliser at the best only affords a very rough indication of its manurial value; yet such knowledge is an indispensable condition of subsequent exact investigation.

Analysis of "Dickson" sludge. Dry basis.

	Sample A, 1912.	Sample B, 1914.	Winnipeg, 1914.
Organic* and volatile	46.79	47.85	47.28
Sand and matter insol.			
in HCl	28.13	27.07	
Phosphoric acid	2.64	4.04	
Lime	4.87	11.10	
Potash	0.26		
Magnesia	—	0.51	
Iron oxide and alumina	—	7.22	
*Containing nitrogen	2.51	2.26	
Nitrogenous ammonia	3.05	2.74	
Moisture	23.06	21.00	4.34

A comparison of the above with the Leeds septic tank sludge analysed by the Royal Commission (April, 1905, Fifth Report, App. S) shows that the former is considerably richer in organic matter and in nitrogen, and there is also much more lime and phosphoric acid in it. In fact the high content in the latter constituents seemed to suggest that some addition had been made, and an inquiry at once elicited the reply that a little superphosphate had been added in order to fix the nitrogen. The moisture content was also high, but this is due to the fact that the standard permissible amount of water in a manure is 18%, and the product was consequently not dried below this point. There is no doubt that complete desiccation can be effected if desired. The presence of a considerable quantity of seed-larks caused some trouble in sampling for analysis, each piece of husk or straw having to be cut up as finely as possible with a small pair of nail scissors. The moisture was determined by heating, by drying *in vacuo* over sulphuric acid, and *in vacuo* over phosphoric oxide. These estimations showed that a not inappreciable evolution of ammonia takes place on warming and on standing in

vacuo over an acid drying agent. A sample containing 20% of moisture began to evolve an alkaline gas at 40° C., another containing less than 1% the same gas at 65° C. Some 13 grams were dried over P_2O_5 in a vacuum of 1–3 mm. of mercury for 14 days. After losing 20.4% in the first 24 hours, it lost almost regularly about 5 mg. per day. After 14 days, nitrogen determinations by the Dumas combustion method gave 2.062 and 2.047, or an average of 2.055%, whereas the original sample before drying gave 2.225% (dry basis) by the same method. The figure obtained for total nitrogen, viz., 21% was the average of nine closely agreeing results by two different methods. It was considerably lower than was expected, but the sample was not a fresh one and also contained added superphosphate. From the results of analyses made in Dublin on fresh material, there is little doubt that an average sample would contain about 3% of nitrogen.

Availability of the nitrogen.

To ascertain the proportion of nitrogen which might, from a chemical point of view, be termed readily available for plant life, the amount which went into solution on digesting the sludge with distilled water for 24 hours at the room-temperature was determined. This was found to be 0.33%, the mean of four results in close agreement. The amount of nitrogen liberated by distilling with an excess of magnesia was 0.4%, and the quantity set free by the same oxide after previous boiling for one hour with 5% sulphuric acid was 0.5%. Exactly the same figure, 0.5%, was obtained by determining the nitrogen evolved as ammonia on boiling for 2 hours with 0.5% potash solution. Considering that the sample analysed was not a fresh one, the above figures indicate that the percentage of available nitrogen was not less than 0.5%, and the ratio of available to total nitrogen was between $\frac{1}{4}$ and $\frac{1}{2}$. These results compare very favourably with those obtained for the sludges investigated by the Royal Commission. The average ratio found in these cases was between $\frac{1}{4}$ and $\frac{1}{2}$. The relatively high proportion of available nitrogen in Manurito is in keeping with the results of the analyses of Leeds septic tank sludge for the Royal Commission, for in both cases the sewage is subjected to anaerobic fermentation.

Ratio of available to total nitrogen in sewage sludges.

Date.	Leeds septic tank sludge.	Leeds settled sludge.	Date.	Dickson sludge.
April 11th, 1905	1:3.6	1:7	1912	1:5
Oct. 29th, 1906	1:5.5	1:11.8	1914	1:4.5

As to the availability of the residual nitrogen, agricultural experience of ordinary sewage sludges would indicate that it is of little importance. Dr. Voelcker, in his report to the Sewage Commission, stated that "nitrogenous organic matter is not the determining factor in the value of sewage sludge." Some laboratory experiments have recently been undertaken to ascertain the extent of nitrification which takes place when Manurito is added to a poor, uncultivated field soil. Although it is yet too soon to draw any valid conclusions, there are distinct indications that considerable nitrification does take place. At first sight it would appear probable that the Dickson material would be very similar to septic tank sludge, since both are products of anaerobic fermentation of sewage, but further consideration leads to the conclusion that there are important points of difference in their mode of origin which might well account for any difference in their fertilising value.

Septic Tank Sludge.	Dickson Fertiliser.
Obtained by anaerobic fermentation of crude sewage.	Obtained by anaerobic fermentation of previously settled sewage sludge.
Fermentation takes place at the ordinary temperature and without additions.	Fermentation proceeds for a strictly limited time, at a definite temperature, and in presence of yeast.
The drying process is usually an extremely slow one, and then only very partial.	The desiccation is very rapid and effective.

The organic matter.

It is quite possible that the manurial value of sewage sludge may be due to the organic matter as such, irrespective of the nitrogen content. There is little doubt that sludge is particularly valuable for consolidating a light soil, and if the analogy holds, since the organic constituents of stable and farmyard manure effect the retention of nitrifying organisms in the soil (see Russell, *Journ. Agric. Sci.* 6, 1, pp. 49, 50), it is very possible that the organic constituents of sewage sludge may play a similar rôle. To ascertain if there is any "superior goodness" in the organic matter of the Dickson fertiliser, some preliminary experiments have been performed of a similar nature to those described by F. K. Cameron ("The Soil Solution") with stable manure. Briefly, these experiments consisted in separating and making aqueous solutions of different soluble constituents of the manure, and using these liquids to water young wheat plants. But whereas Cameron's experiments were performed with water-cultures and observations were apparently confined to tracing the effects on aerial and root development, in this case sand-cultures were used and the change in weight of the plants, as well as the growth of the leaves, was investigated.

Thirty grams of the fertiliser were digested with 160 c.c. of distilled water at the room-temperature. The liquid was then filtered and one-third of it diluted so that the amount of dissolved solids in it did not exceed 0.1 gram per 100 c.c. [solution F]. The remainder was treated with an excess of 90% alcohol. The nearly white flocculent precipitate of organic matter was filtered, washed with alcohol and dried near an oven. It was then dissolved in water and the solution so diluted that it contained the same proportion of organic matter as was present in solution F [solution O]. As the earlier experiments were performed with "Manurito" to which a little superphosphate had been added (see above), the precipitated organic matter was contaminated with phosphate and sulphate; but the same general results were obtained later when a sample free from added superphosphate was employed. The organic matter was of a colloidal nature and was found to evolve ammonia on heating with soda-lime, showing the presence of nitrogen.

The filtrate from the alcoholic precipitation was boiled until all the alcohol was expelled and was then diluted to the same degree [solution M]. This liquid therefore contained the soluble mineral constituents of the fertiliser and organic matter which was not precipitated by alcohol. In some cases a solution of the mixed organic (O) and mineral (M) portions was also used. The sand used was coarse and very carefully purified by twice boiling either with hydrochloric or with nitrohydrochloric acid and thoroughly washing with tap- and distilled water. Finally it was baked on a hot-plate. The wheat plants were germinated in garden soil which had not been under cultivation for at least three years. Incidentally it was observed that the germinating power of the seeds diminished considerably as the soil was used over and over again, even after thorough aeration. The plants were removed from the soil when from 10–20 days old, their roots were carefully freed from adhering soil and then washed in running tap-water for about 1 hour. After drying for about the same period on filter paper they were weighed. At the end of the experiment they were air-dried for 24 hours before weighing. In nearly every case, similar plants watered with distilled water were grown as control. All the solutions used were previously passed through a Berkefeld filter. It was not considered necessary to attempt to sterilise the plants because, *inter alia*, the control experiments with distilled water would eliminate the bacteriological factor.

The aerial growth was determined by measuring the length of the leaves. A leaf was considered to be alive if blanched, but dead if brown or red in colour.

The appended table gives the comparative results of the action of the different solutions upon initially similar young wheat plants, which are denoted by the same letters as the solutions used to water them. The best developed plant is given first.

	Period of growth.	Aerial development.	Increase in organic matter.
A.	12 days	$\begin{Bmatrix} M \\ F \end{Bmatrix}$	—
B.	12 days	$\begin{Bmatrix} O \\ M \end{Bmatrix}$	—
C.	28 days	$\begin{Bmatrix} M+O \\ O \end{Bmatrix}$ M W	M+O F O M W
D.	28 days	F O W M+O M	W M+O F M
E.	20 days	F O M	$\begin{Bmatrix} F \\ O \end{Bmatrix}$ M
F.	20 days	$\begin{Bmatrix} M \\ O \end{Bmatrix}$ $\begin{Bmatrix} F \\ O \end{Bmatrix}$	M $\begin{Bmatrix} O \\ F \end{Bmatrix}$ W
G.	20 days	O F W M	$\begin{Bmatrix} O \\ F \end{Bmatrix}$ $\begin{Bmatrix} M \\ W \end{Bmatrix}$
H.	18 days	O M F W	$\begin{Bmatrix} O \\ F \end{Bmatrix}$ W
I.	18 days	F O W M	O F W M

Labour	s. d.
Fuel	2 2
Power	15 0
Stores	4 7
.....	3 3
Total	25 0

The conditions at Dublin have been by no means ideal for cheap working, and it is very probable that a considerable reduction in working costs may be effected. Were the heat from a refuse destructor available, costs would be very greatly reduced; and it is also possible that money might be saved by utilising the gases evolved in the fermentation troughs for the production of heat. As the process is continuous and automatic, the labour required at Dublin is small, viz., three workmen and one engineer to each shift. There is but little smell noticeable, and that is confined to the trough house, whilst the health of those who carry out and supervise the operations is good.

The centrifuge system of effluent purification.

Probably the greatest drawbacks of effluent treatment in percolating filters are high initial cost and the absolute necessity of expert management. Both of these disadvantages are obviated by the centrifuge system, which at the

In addition to showing that the aqueous extract of Mamurto had a very marked beneficial action upon the plant development, these experiments also indicated that the soluble organic constituent produces an effect equal in intensity to that of the fertiliser itself.

It is probably illegitimate to draw any conclusion about the relative inferiority of the solution M, since its contents may have been profoundly altered when they were boiled to distil off the alcohol. This inferiority was in nearly every case very marked, in fact the plants watered with it usually did less well than the control plants with distilled water. This may be due to the presence of a toxin or toxins undestroyed by heat. In one or two cases, when the period of growth was prolonged, the M plants, after doing badly at first, seemed to recover their vitality. In all such experiments the factor of intrinsic vitality comes into play, and it is necessary that more of them should be undertaken before any stringent conclusion can be drawn. The results given above, however, afford distinct indications, and agree with those performed by F. K. Cameron with aqueous extracts of stable manure and water cultures. A few similar experiments have also been done with septic tank sludge and with the same results. The amount of soluble matter in the Dickson fertiliser (without additions) was, however, found to be about double that in the specimen of tank sludge investigated. The precipitated organic matter from the latter was also relatively smaller in amount, had a most unpleasant smell, and was of a darker colour.

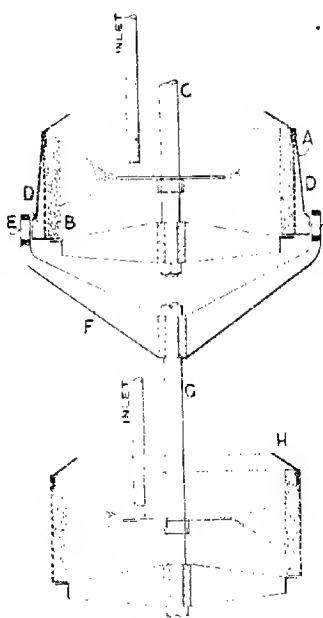
As to the *modus operandi* of the fertilising action of the organic matter, there appear to be three probabilities. It may serve directly as a plant food; it may act indirectly by improving the moisture-retaining property of the soil, and it may provide nutriment for beneficial bacteria. That the second mode was operative appears very probable from the observation that the sand of the F and G plants retained its moisture much longer than that of the other plants; and the indication of nitrification referred to above constitutes evidence in favour of the third.

All the evidence so far obtained confirms the opinion that a commercial valuation of a natural fertiliser such as "Mamurto," based solely upon the chemical analysis, is of little or no value. Both the plain and compound "Mamurto" have been extensively tried by farmers and nurserymen in England and Ireland, and the results indicate that the intrinsic value is certainly not less than the market prices of £2 10s. and £3 13s. 6d. per ton respectively. At these prices the manures command a very ready sale.

Costs.

The cost of treating sewage sludge by the Dickson process depends upon various factors, of which the price of energy for the production of heat is by far the most important. At Dublin the coal employed is both inferior and expensive, so that the total costs, exclusive of those for interest and administration, work out to 25s. per ton of fertiliser produced. This sum is accounted for as follows:—

Fig. 7.



same time yields an effluent superior to any other as regards suspended solids and dissolved oxygen. The apparatus is remarkably simple in construction (see Fig. 7). It is merely a centrifugal machine of which the cage or basket, A, B, is provided with an annulus of a filtering medium, *e.g.*, sand, B. The speed of rotation, normally about 400 per minute, keeps the sand adhering to the metal basket as a compact mass. This centrifuge, or hydro-extractor, is supplied with a patented device for scraping and removing the inner portion of the sand without interrupting the process of filtration. The spindle, C, G, carries a horizontal disc which rotates with it and serves to distribute the liquid as it falls upon it. The energy contained in the outflowing liquid is trapped by making it drive a turbine, the power thus recovered helping to reduce the small amount required for rotation. In its passage through the

interstices of the annulus, the effluent is not only thoroughly aerated and deprived of its suspended matter, but colloidal matter is apparently broken down, precipitated and removed. The aeration is to a large extent independent of the nature of the filtering medium, for even very coarse material effects saturation. A bad sewage effluent is found to be practically saturated with dissolved oxygen after one passage through the apparatus. The degree of removal of the suspended solids varies directly with the fineness of the medium and the speed of rotation. Such solids can be entirely eliminated if necessary, but there is naturally an economic limit beyond which it is inadvisable to work. The reduction in the quantity of dissolved solids in the effluent from the hydro-extractor supports the conclusion that nitrogenous organic matter undergoes decomposition and oxidation in its passage through the machine. As regards the effects of this process on bacterial life, recent tests have shown remarkable results, and indicate the total elimination of *Bacillus coli*.

A plant for both Dickson and centrifuge processes has been in operation at Winnipeg for some time past. To ascertain the capabilities of the last-named process, some tests were recently carried out by the City Analyst on raw sewage, i.e., there had been no preliminary sludge separation or treatment of any kind. The sewage was passed through a centrifuge, then given a half-hour treatment in a very small contact-bed, and finally passed through a second centrifuge.

Preliminary examination on Sewage from Aubrey Street Sewer, Winnipeg. Samples Collected February 17th, 1914.

Results stated in parts per million.

Free oxygen—			
1st Hydro-extractor	10		
2nd Hydro-extractor	13		
Solids.			
	Total.	Volatile.	Fixed.
Raw sewage	2758	1129	1629
1st Hydro	2928	628	1700
2nd Hydro	1480	396	1180

The aeration and purification of polluted waters by the centrifuge process is well illustrated by the following experiments on fish life. It is well known that salmon alevins are exceedingly sensitive to a diminished oxygen supply. Six of these, about $\frac{3}{4}$ inch long and with their yolk sacs attached, were placed in the Dublin city effluent in a small vessel which was completely filled with the liquid and then hermetically covered. Four fish became "as if dead" within five minutes, and within another two minutes the remaining two followed suit. The motionless fish were then placed, under precisely the same conditions, into some of the effluent which had been passed through a hydro-extractor. In a few minutes they revived and were soon seen swimming about full of life, in fact they seemed to be just as healthy as some of their brethren who had been confined in tap-water as control. It was also found that minnow, a harder fish, will live in unchanged hydro-effluent for five days, whereas control specimens in tap-water sometimes died within a shorter period. Some minnow were placed in water containing free sulphuretted hydrogen. After ten minutes they were all floating near the surface in an unconscious condition. They were then removed and put into some of the same contaminated liquid, but which had been once passed through the centrifuge. In about fifteen minutes they had to all appearances completely recovered. The centrifuged liquid had no smell, and lead acetate solution failed to show any signs of hydrogen sulphide—it had been oxidised to sulphuric acid. In a similar manner, it is found that ammonium sulphide undergoes oxidation to ammonium sulphate, a fact which may be utilised in the purification of, and recovery of ammonia from, the effluent from coke oven processes. Such a rapid and inexpensive method of effecting oxidation should be of considerable service in chemical investigation and routine

	Solids.			Oxygen consumed from permanganate.		
	Total.	Volatile.	Fixed.	Solids in solution.	Solids in suspension.	Three-minute period.
Raw sewage	2758	1129	1629	2135	603	152
1st Hydro	2928	628	1700	2085	242	92
2nd Hydro	1480	396	1180	1468*	18	26

* Domestic Water Supply, 1190.

The following table gives the average of eight analyses, taken at random, of the Winnipeg effluent after treatment, the sludge having previously been precipitated. April and May, 1914. Parts per million.

	Sewage.	Effluent.	Reduction.
Free ammonia	11	11	3
Albuminoid ammonia ..	11	3	11
Oxygen consumed from permanganate	85	9	76
Free oxygen	2	14	12
Total solids	1970	1020	(over 50%)

The remarkable nature of these results may in part be due to the fact that the sewage at Aubrey Street is in a fairly fresh condition. The dissolved oxygen absorption test appears not to have been carried out, but the number of bacteria per c.c. were counted.

Sewage	81,500,000 bacilli per c.c.	Many <i>B. coli</i> .
Effluent after treatment	1,150,000 bacilli per c.c.	No <i>B. coli</i> .
Reduction per c.c.	80,350,000	

These figures were considered so remarkable that the examination was repeated. The second test confirmed the first.

work. However that may be, the above experimental results leave no doubt that the centrifuge system would be of very great utility for the purification of effluents which are discharged into fish rivers. The cost of the process amounts to one-third of a penny per 1000 gallons for one treatment, and three farthings for a double treatment. There is no nuisance from smell during operation, the power required is small, as are also the space needed and the wear and tear. The use of the apparatus is independent of the size and position of the locality, and small communities can be served as efficiently as large. It might with advantage be used for disposing of the sewage of country houses. One treatment would separate the solids, which could be dug into trenches, and the effluent could be run directly on to the land.

Further applications.

Not only ordinary sewage effluents, but liquid trade waste of nearly all descriptions could be cheaply and effectively treated in the centrifuge. It has already been in service for some time at a big co-operative creamery near Limerick Junction, Co. Tipperary. The waste liquid is treated with mineral phosphate in small sedimentation tanks, the effluent passing first to a catchment tank containing sand and stones to trap the solids, and then through the centrifuge. The recovered solids contain 44.41% of total phosphates, of which 43.01% is soluble in 2% citric acid; and 0.42% of nitrogen; they are sold as a fertiliser at 36 shillings per ton.

The unpleasant smell of swimming baths is probably connected with the lack of dissolved oxygen in the water, and a simple passage through the centrifuge would doubtless restore to the water its natural freshness. There seems to be no reason, apart possibly from that of expense, why it should not be used for filtering the water supply of towns, and for ocean-going vessels and military purposes its possible application should not be overlooked. It would be interesting to find out if it could be used for softening water. If the filtering medium were composed of zeolites, or of sand and zeolites, or other precipitants, it is possible that the dissolved solids which cause the hardness might be precipitated and caught.

Costs.

The capital outlay required to instal a complete Dickson-centrifuge installation would naturally vary with the local conditions. For a town of 100,000 inhabitants, the approximate cost would be £80,000, which would include sedimentation tanks but not sewers or land. The figure would be proportionately smaller for larger towns, but greater for smaller communities. For a town of 1000 inhabitants the capital cost would be about £5000. As regards working costs and upkeep, the proceeds of the sale of the fertiliser would probably go a long way to meet these, as the Dickson process is a remunerative one. The net total cost (all in) is expected to work out to approximately 2s. per head per annum.

The credit of having solved the practical difficulties connected with the yeast-separation and the drying of the sludge, is due to Mr. T. W. Barber, M.I.M.E., and he alone is responsible for the centrifuge method of treating effluents.

Whether the Dickson Centrifuge process of sewage treatment and disposal eventually comes into general use or not, few will deny that it presents some novel and interesting points of scientific and utilitarian import.

The author wishes to express his thanks to the proprietors of the Dickson Centrifuge patents for their kindness and courtesy in allowing him to inspect the works at Dublin, and in providing him with information; and also to Mr. H. M. Freear, of the Woburn Pot Culture Station, for much valuable advice on the agricultural experiments.

DISCUSSION.

Dr. S. RIDEAL said he could not quite understand why the first operation was necessary, if the hydro-extractors did all the work. How was it that a contact bed was necessary between the first and second hydro? One would have thought that some continuous process, by which the sewage passed from one hydro to a second one, would have saved intermediate contact beds. There was no evidence given of the chemical and bacterial changes which took place during that intermediate stage in the process. The sludge seemed to be very similar to any other sludge, with 9 to 11% of solid matter and 80–90% of water. Thus there was about 90% of water to be eliminated from that raw sludge, and even the top sludge in this process might contain 80%. To eliminate the 80% of water remaining in the yeast-fermented sludge, 1 lb. of coal was necessary for distilling off 4 lb. of water which was associated with every pound of organic matter. That was not a very good efficiency for the coal used. It meant that the principal portion of the process was the expensive operation of removing the water from the yeast-fermented sludge, and that was the difficulty in any process of sludge disposal. He had seen the Ter Meer process at work at Hanover, at Frankfurt,

and also at Harburg; it consisted in centrifuging the sludge removed from the bottom of sediment tanks. No yeast was used, but the sludge rose from the bottom of the tanks automatically by gravity pressure direct into the centrifuge, where water was separated. The sludge, passing away out from the centrifuge, contained about 70% of water and was sufficiently solid to be handled. The amounts of nitrogen and phosphorus in all these sludges were practically the same and all were of very little value. The increase in the nitrogen did not mean that that sludge could be valued at 50 shillings a ton. It was a really fictitious price for sludge. Some time ago he had collected the products from Dublin sewage which was being discharged untreated near the Pigeon Hole Fort, and had found the majority of the solids were not nitrogenous and would have practically no manurial value even if they were separated by the yeast process. It was unfortunate that inventors of new processes for utilising sewage tried to improve the sludge by adding phosphates and nitrogen so as to increase its manurial value. If the sludge had any value *per se*, it ought to be sold as such without addition.

The discussion was then adjourned, and was resumed on April 12th, 1915.

Dr. E. HOWARD TRIPP said that the drying of septic-tank sludge was a very slow process, and it was quite common to find about 60% of water even in pressed cake. In the case of the Dickson fertiliser, the desiccation was very rapid and very effective. The Dickson fertiliser again was absolutely sterile after it had been made, whereas that was not the case with the septic tank sludge. Preliminary experiments with the fertiliser had given very favourable results, and it had now been arranged that systematic plot tests should be carried out at one of the foremost agricultural institutions in this country.

They did not centrifuge the raw sludge, because about 50% of the nitrogen, normally present in the sludge, was lost when the effluent was centrifuged. The nitrogenous matter was broken down, and went into solution. It was believed that the changes induced by the yeast were beneficial, and produced a fertiliser which was not to be obtained by other means.

The Ter Meer centrifuges referred to by Dr. Rideal only reduced the water content to 70%, which could not be called drying sludge. They could with a Dickson centrifuge get down to 20% of moisture, or less if necessary. The amount of desiccation effected would depend upon the fineness of the medium and the speed of rotation, but there was naturally an economical limit, beyond which it was not feasible to go. He understood that the Ter Meer centrifuges had not found application anywhere outside Germany, and that the residual sludge was about as difficult to deal with as the original sewage, and the effluent from such machines constituted a problem in itself.

A contact bed was not absolutely necessary, but advisable, as it enabled the work of the first hydro, namely, super-saturation of the effluent with oxygen, to be utilised. The oxygen of super-saturation in the effluent acted very rapidly indeed in the contact bed, and the rate of flow through the contact bed was about 500 times the normal rate of flow for a normal contact bed. Hence only a very small bed was necessary.

Mr. F. R. O'SHEENESSY said he had made some experiments with a moderately strong sewage, and the results obtained on passing this sewage through the "Hydro-centrifugal machine" were as follows:—

(Results in parts per 100,000.)

	Suspended Solids.	Colloidal Solids.	Free Amm.	Albd. Amm.	Oxygen Absorbed.		
					Unact.	Set.	Clarified.
Sewage before treatment	6.5	10.5	4.02	1.12	20.45	15.65	14.31
Effluent from "Hydro"	1.5	5.5	3.95	0.96	19.45	15.65	14.12
Effluent sand after "Hydro"	2.0	5.5	3.85	0.70	18.14	15.13	13.83

The three minutes oxygen absorbed figures corresponded with the above results, and showed conclusively that the purification in the machine was almost negligible. The behaviour of the machine and the appearance of the sand in the "Hydro" indicated that a portion of the solids was retained on the sand, which quickly choked up. Further experiments with the two principal constituents of sewage, viz., urine and faecal matter, made into aqueous mixtures corresponding to those found in sewage, showed that little oxidation (if any) had taken place in the machine. In passing the faecal emulsion through the machine, the sand very quickly choked up and rendered the machine useless. The apparent purification was due to the abstraction of solid matter by the sand, which became covered with sticky colloidal matter.

This operation, which produced such a negligible purification, appeared to cost about as much as the whole of the operations needed to purify the sewage completely by one of the well-known and well-tried methods at present in general use, together with the cost of sludge disposal.

The utilisation of sludge as a manure was an economic question. It was generally admitted now, that to attempt to recover the mineral elements of the soluble portions of sewage on a large scale in this country on land directly was impossible. That ruled out more than 50% of the mineral elements present in sewage, and, of course, by far the most easily available. The remainder, *i.e.*, the sludge, had been washed most thoroughly by its long contact with water, and therefore anything that was immediately available was carried away. In his own experiments in the fermentation of sewage sludge, he had found that something like 25% of the organic nitrogen in the sewage sludge—and this was true of the organic matter generally—was broken down by biological action. The other nitrogenous elements were extremely stable, and would last for an indefinite time without any very apparent diminution. The net result was that sewage sludge as a manure could only be considered in the nature of a filler, when mixed with really valuable fertilisers, such as phosphates and potash salts. All the experimental evidence which had been produced up to date showed that the nitrogen of sewage sludge could only be recovered in one way, namely, by destructive distillation. At Birmingham the preliminary treatment consisted in digesting the sludge in order to destroy its objectionable characteristics (see this J., 1914, p. 3). That process was going on at the present time on an enormous scale, and was treating successfully the sludge of one million people. The final product resembled peat, and had given satisfactory results in producer-plant. By means of that process, they could get substantial nitrogen recovery in the shape of ammonium sulphate, together with tar, producer gas, and other products.

Dr. TRIPP, in reply, said with regard to the working of the hydro-extractor, it was very obvious that the figures that Mr. O'Shaughnessy had put forward were in marked and violent contrast to such figures as were obtained in Winnipeg. He did not think it was quite right to take a solution of urine in doing experiments of this kind. Sewage as obtained at the outfall and at the sewage works was very different in composition to that which originally went into the drains, *e.g.*, there would be no urine left as such, owing to the enormous amount of change it would have undergone in the sewers. He had heard very little about the centrifuge tests at Birmingham. He understood that the centrifuge was the first one of a new type and did not do its work completely, because it was enclosed in an encasement which had not been provided with perforations, so that the air which came through with the water could not escape; hence a back pressure resulted, and clogging took place. Further, it was not intended that a raw sewage, especially of the character of the Birmingham sewage, should be passed into such a machine without preliminary precipitation. A centrifuge had been in use at Dublin for some time past, and another in Yorkshire, and in every case the information had been that they had worked successfully. In the residual nitrogen of ordinary sewage sludge the agricultural chemist was up against a tough proposition. He agreed with Mr. O'Shaughnessy as to the value of

ordinary sewage sludge; but he did not see what bearing that had upon the fertiliser produced by the Dickson process. The argument from analogy was always a dangerous one, and in the present case there was no degree of similarity between the two products.

Meeting held at Burlington House on Monday
April 12th, 1915.

PROFESSOR W. R. HODGKINSON IN THE CHAIR.

Further exhibits were shown by the Worcester Porcelain Company of crucibles, etc.

Mr. MONSON produced samples of kapok (*Bombac malabaricum*), of which the best quality, from Java, was used in life-saving jackets, having a sustaining power much higher than that of the inferior qualities. Other kinds came from Ceylon, Calcutta, and Bombay. The prices varied from about 4d. to 8d. per lb. The inferior qualities were apt to be adulterated with waste cotton, and so on; cotton was stained more deeply by iodine than kapok, and in that way it could be differentiated. Kapok was also beginning to take the place of eiderdown. Vermin would not go near it. It was of no use for weaving or spinning. It was often adulterated with *Crotalaria procera*, which had been proved to be quite useless.

Dr. R. ROBERTSON said that one way of distinguishing between kapok and cotton was to submit it to such a process as that of Messrs. Cross and Bevan for estimating resistant cellulose. Cotton, after having been subjected to this process, would have somewhere about 95%, but the kapok only about 50% of resistant cellulose.

Mr. W. F. REID said he had made a great many tests of kapok. He had nitrated and made gun-cotton of it, and had found that the nitro-cellulose was probably not stable, but cellulose could be obtained from it in very large quantities. The bulk of it came from Java originally; but in West Africa there was an inferior kind produced from a creeper. The pods were nearly the size of a cocoa pod, and each contained a large quantity of fibre. The vine yielded a little rubber. When he was technical expert to the Royal Aero Club, he had suggested that the cars of the balloons should be lined with the material. The water-repellent power was in inverse proportion to the quality of the fibre as indicated by its market price. The yellowest varieties were the best for the purpose. It could be immersed in water for a week or two, and the water would not penetrate it. The fibre was also very brittle. If it were grown in large quantities, it might be used as a source of cellulose for paper, and similar purposes, as it was cheaper to grow than cotton; but it would first be necessary to extract the resinous matter in it, which repelled water; it was a kind of wax which could be extracted very easily, and might even be used commercially.

Meeting held at Burlington House, on Monday,
May 3rd, 1915.

PROF. W. R. HODGKINSON IN THE CHAIR.

THE FUNCTION OF LITHARGE IN THE VULCANISATION PROCESS.

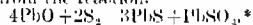
BY HENRY P. STEVENS, M.A., PH.D., F.R.C.

LITHARGE is an ingredient of a large class of rubber goods, of which boot, shoe, and golosh compounds are of especial interest. In the manufacture of

these goods the proportion of sulphur is kept very low in order to prevent sulphuring of the articles after vulcanisation, and the proportion of litharge is frequently very high.

It is well known that certain minerals, such as magnesia, antimony sulphide, etc., as well as litharge, promote vulcanisation when incorporated in the rubber mixing. Technically the result obtained is a correctly vulcanised product in a shorter time or at a lower temperature than would have otherwise been necessary. The state of vulcanisation is judged by the ageing qualities and the physical qualities generally. It is known that these are correlated with the coefficient of vulcanisation, that is the percentage of "combined" sulphur when calculated on the rubber in the product. Too high a coefficient of vulcanisation points to an overcured product, and too low a coefficient to an undercured one. The correct coefficient would probably vary with the raw rubber and possibly also with the type of mixing. I have usually found that for soft rubber mixings a figure of about 2.5 to 3 corresponds with the optimum physical condition of the freshly vulcanised rubber. This figure should be borne in mind when interpreting the results in the following tables.

The effect of litharge in promoting vulcanisation is usually attributed to the rise in temperature resulting from the reaction.



The investigation of this subject presented various difficulties, especially in the way of analysis, and it became necessary to work out a method for determining the sulphide and sulphate sulphur in the vulcanised product.† It was found that, after the rubber had been thoroughly swollen in a solvent such as ether, it was possible to decompose the sulphide completely by warming with acid and to collect and estimate the hydrogen sulphide evolved, whereas the sulphate formed was removed by extraction with strong hydrochloric acid in the presence of the solvent. The amount of sulphate obtained was invariably less than would have been expected from the above equation, and it is possible that part of the rubber was oxidised and a smaller proportion of sulphate to sulphide produced.

This new method for the analysis of vulcanised litharge mixings was applied to a series containing the same amounts of raw rubber (100 parts) and sulphur (5 parts), with increasing proportions of litharge. One part of sulphur is almost exactly the amount required for the conversion of 7 parts of litharge to lead sulphide (or sulphate). Taking the figure 2.5 as the coefficient of vulcanisation of the rubber, it follows that a mixing with the above proportions of rubber and sulphur, together with 17½ parts of litharge, will contain sufficient sulphur to vulcanise correctly the rubber, and at the same time to convert the whole of the litharge into lead sulphide. When the mixing contains a larger proportion of litharge than this, there will be insufficient sulphur to vulcanise fully the rubber and to convert the whole of the litharge to lead sulphide. Under these latter conditions one would expect the rubber and litharge to compete for the sulphur present, and the distribution of the sulphur between them should throw much light on the changes taking place during vulcanisation. If rubber and litharge should be more or less equal in their avidity for sulphur, this will allow the employment in practice of a very large proportion of litharge without danger of overcuring the goods, provided that the amount of sulphur is restricted. The figures in the following tables bear out this view and show that the coefficient of vulcanisation falls when the proportion of sulphur

is insufficient to convert the whole of the litharge to lead sulphide, and at the same time leave sufficient to cure the rubber fully.

The list of the mixings employed is given in the first table. The table also shows the amount of sulphur required to convert the whole of the litharge present to lead sulphide, and the percentage of sulphur as calculated on the whole mixing. The rubber employed was an air-dried plantation sheet rubber of good quality.

TABLE I.

No.	Rubber.	Sulphur.	Litharge.	Sulphur required to convert litharge to PbS or PbSO ₃ .	S in mixing
1	100	5	nil	nil	5.0
2	100	5	7	1	4.16
3	100	5	14	2	3.20
4	100	5	17.5	2.5	2.68
5	100	5	21	3	2.37
6	100	5	25	4	2.13
7	100	5	35	5	1.67
8	100	5	42	6	1.43
9	100	5	56	8	1.11
10	100	5	79	10	0.86

Tables 2 and 3 give the figures obtained on analysis of the vulcanised mixings. Two cures were made, one for 2 hours and one for 3 hours, at 132° C. The mixings were vulcanised in moulds between thin sheets of tin plates.

TABLE II.
Specimens cured for 2 hours.

No. of sample.	Percentage of sulphur found (calculated on whole mixing).			Percentage of sulphur calculated on raw rubber used.		
	Free sulphur.	Sulphur present as lead sulphide.	Combined sulphur by difference.	Free sulphur.	Sulphur present as lead sulphide.	Combined sulphur by difference.
1	3.84	nil	0.02	4.04	nil	0.06
2	2.43	0.61	0.10	1.32	2.74	0.11
3	2.00	0.73	trace	1.47	2.58	0.87
4	0.77	1.17	trace	2.14	0.94	1.44
5	0.87	1.25	0.17	1.68	1.10	1.58
6	0.53	1.31	0.22	1.70	0.70	1.74
7	0.18	1.46	0.35	1.58	0.25	2.04
8	0.07	1.62	0.11	1.30	0.10	2.08
9	0.07	1.74	0.40	0.01	0.11	2.78
10	0.07	1.47	0.30	0.12	2.57	0.33

TABLE III.
Specimens cured for 3 hours.

No. of sample.	Percentage of sulphur found (calculated on whole mixing).			Percentage of sulphur calculated on raw rubber used.		
	Free sulphur.	Sulphur present as lead sulphide.	Combined sulphur by difference.	Free sulphur.	Sulphur present as lead sulphide.	Combined sulphur by difference.
1	3.00	nil	1.76	3.14	nil	1.86
2	1.88	0.63	trace	2.05	2.11	0.30
3	1.21	0.69	0.10	2.20	1.14	0.82
4	0.27	0.86	0.20	2.75	0.34	1.05
5	0.48	1.00	0.13	2.36	0.61	1.26
6	0.39	1.13	0.23	2.01	0.52	1.50
7	0.23	1.13	0.28	1.61	0.31	2.00
8	0.00	1.70	0.37	1.27	0.09	2.50
9	0.01	1.86	0.31	0.87	0.06	3.00
10	0.07	1.71	0.30	0.75	0.12	3.04

* Lech and Auerbach, Ueber die Wirkung des Bleioxyds bei der Vulkanisation des Kautschuks, Gummi-Markt, 1901, p. 123.
 † New South Wales-Zeitung, 15, 710 and 718.

† Stevens. Paper read before the Society of Public Analysts.

Sample 1, containing no litharge, was inserted for purposes of comparison, although it was under-cured in both instances. The combined sulphur was checked by a determination on a separate portion of the specimen in some instances. The effect of treating the rubber with solvent and acid to liberate the sulphide sulphur causes a part of the vulcanised rubber to undergo decomposition, so that a portion of it and of the sulphur with which it is combined passes into solution. It is therefore necessary, in determining the combined sulphur directly, to include not only the sulphur retained by the residual rubber, but also any recovered from the solution in the solvent. The figures obtained with the first 5 specimens, Nos. 2-6 in Table III, were as follows:—

No. of sample.	% Sulphur in rubber.	% Sulphur in ether extract.	Sum of the foregoing being % of combined sulphur.	% Combined sulphur calculated on the raw rubber.
2	1.88	0.16	2.04	2.28
3	1.92	0.19	2.11	2.61
4	2.41	0.19	2.60	3.19
5	2.11	0.22	2.33	2.94
6	1.93	0.20	2.13	2.83

These figures agree sufficiently closely with those determined indirectly. Although the percentage of sulphur is calculated to the second place of decimals, it is not intended to imply that the figures are correct to more than one place of decimals. Where, however, it becomes a matter of adding together determinations of a number of constituents, the second figure has some significance. The last four columns in Tables II. and III. give the results as coefficients of vulcanisation, the corresponding percentage of total sulphur being 5 in all cases. The following conclusions may be drawn:—

(A) That the addition of litharge in moderate quantities increases the coefficient of vulcanisation as may be seen from comparing mixings 2, 3, and 4 with 1.

(B) That the maximum coefficient of vulcanisation for both cures is obtained with mixing No. 4, in which there is just sufficient sulphur to cure the rubber fully and to convert the whole of the litharge to lead sulphide and sulphate.

(C) That increasing proportions of litharge cause a progressive reduction in the coefficient of vulcanisation, a larger percentage of lead sulphide and sulphate being formed.

(D) That the percentage of free sulphur drops suddenly at the point where the rubber is fully cured. This corresponds with the appearance of the vulcanised specimens. Samples 1, 2, and 3 in both cures sulphured up in the ordinary manner. Samples 4-10 showed no sign of sulphuring up even after keeping for months. In both cures the free sulphur is lower in mixing No. 4 than in No. 5. This sudden break in the regular decrease in the figures for free sulphur was so remarkable that repeat tests were made by re-extracting fresh portions of the vulcanised rubbers. The figures given above are the mean of two results, e.g., Mixing No. 4: percentage of free sulphur 0.30 and 0.25; mean, 0.27%. Mixing No. 5: percentage of free sulphur, 0.11 and 0.51; mean, 0.48%.

(E) That even with large proportions of litharge a little free sulphur always remains. The figures show some irregularity for mixings 9 and 10 in Table II. and mixing 10 in Table III. There is a tendency to an increase in the proportion of free sulphur and a reduction in the proportion of sulphur present as lead sulphide and lead sulphate. In Table II. the sulphur as lead sulphide shows a marked fall, and in Table III. the figure is practically stationary. Further experiments with

larger proportions of litharge are necessary to ascertain whether at this point a change takes place in the relative distribution of the sulphur, or whether the irregularities in the figures are purely accidental.

Newcastle Section.

Meeting held at Bolbee Hall on Wednesday, April 21st, 1915.

PROF. H. LOUIS IN THE CHAIR.

THE INTER-RELATIONSHIPS BETWEEN THE CONSTITUENTS OF BASIC SLAG.

BY S. H. COLLINS AND A. A. HALL.

The constituents of basic slag other than phosphorus have barely received due recognition. To a certain extent the value of the lime has been acknowledged and of recent years much has been made of the citric solubility test, but otherwise little attention has been paid to the other constituents.

Analytical methods.—For the general analysis about two or three grams was treated with about 10 c.c. of strong hydrochloric acid and a few drops of nitric acid in a wide, flat-bottomed dish and evaporated to dryness. When dry the mass was again treated with a smaller quantity of hydrochloric acid and evaporated a second time, after which the residue was dissolved in hydrochloric acid and water, filtered, and washed into a half-litre flask and made up to that volume. The phosphates were precipitated from 25 c.c. or 50 c.c. of the above solution by the molybdate method and weighed as the blue compound obtained on heating the yellow precipitate. The weight multiplied by 0.01 gives the weight of P_2O_5 . A separate amount of 100 c.c. of the solution of slag was treated with citric acid, ammonia, acetic acid, and ammonium oxalate to precipitate calcium, and the filtrate treated with much ammonia to precipitate magnesium as magnesium ammonium phosphate. For estimating manganese a separate quantity of the slag solution was treated with much barium carbonate, filtered from the precipitate of ferric phosphate, etc., and the manganese titrated at the boiling point with permanganate solution. The iron was determined by titration with titanous chloride using thiocyanate as indicator. The vanadium was determined in a special sulphuric acid solution by first oxidising with permanganate and then titrating with ferrous sulphate, using potassium ferrocyanide as external indicator.

The citric-soluble constituents were determined by Wagner's method. The fineness is the percentage passed by a standard sieve containing 10,000 meshes to the square inch.

The available lime is the lime soluble in citric acid which exceeds the amount of lime necessary to combine with the phosphoric acid soluble in citric acid to form $Ca_3P_2O_8$. That is, the citric-soluble lime and phosphoric acid are redistributed so as to be represented by the citric-soluble tricalcium phosphate and available lime. The sum of the first pair equals the sum of the second pair.

The correlation amongst the constituents.—The results of analysis shown in Table I exhibit certain relationships. The most interesting point is to consider the relationships occurring between the citric solubility and the general composition. As it is desirable to obtain as many data as possible

when working out coefficients of correlation, we have included many results from partial analyses not in the table now published. Since the coefficients thus calculated will differ in reliability according to the number of figures used, the probable errors of these coefficients have also been determined.

The coefficient of correlation is determined from the formula:—

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}}$$

where x is the departure from the mean of the citric solubility and y is the departure from the mean of the fineness or other property supposed to be correlated.

When correlation is perfect the formula works out to be equal to unity, when there is no correlation the result is zero, and when the quantities move in opposite directions the result has a minus sign.

The probable error of the coefficient is calculated from the formula:—

$$\mu = \frac{0.674 (1-r^2)}{\sqrt{n}}$$

in which r is the coefficient and n is the number of pairs which are correlated.

The correlations may also be represented by a graph, as has been done in the accompanying diagram for the case of the correlations between the citric solubility and the lime or magnesia. When the single tests are plotted, the resulting form is too scattered to admit of any clear interpretation. If, however, the results of the analyses are placed in the order of citric solubility and then averages taken of each consecutive ten analyses and the averages plotted, as in Graph 1, then a definite figure shows. The curves are only very rough, but show that there is a strong correlation between the citric solubility and the lime or magnesia. The coefficients of correlation corresponding to this graph are +0.52 for the lime and -0.31 for the magnesia.

The correlation between the citric solubility (see Table 3 and Graph 1) and the lime is very striking and shows that a high lime content and a high citric solubility are very intimately connected. This remark evidently applies only to slag, since Robertson has shown* that in other cases the opposite holds true. The correlation between citric solubility and fineness is to be expected, but that the lime content has more influence on citric solubility than has the fineness is hardly a foreseen result. The evil influence of silica is strikingly represented by the substantial figure -0.35, a result that has certainly surprised the authors. Magnesia appears to hinder the solution of a slag in citric acid, but unfortunately the importance of magnesia was not recognised when these investigations started ten years ago, with the result that fewer analyses are available and the probable error is in consequence larger. Manganese, iron, and vanadium may be dismissed as having no important influence on the citric solubility. That there is a correlation between the citric solubility and the total phosphates may be explained in many ways. High grade phosphates fetching a high price per ton are likely to receive more attention from the manufacturer than those slags which fetch a lower price per ton, the correlation may be the result of finer grinding of the richer slags and, of course, if there is more phosphate there is less of the other constituents and therefore less matter to obstruct the action of the citric acid.

The correlation between the hay crop and the constituents of the basic slag.—During the ten years

from 1904 to 1913, fifteen plots of land have been experimented with, the records of which have been published in the Cocker Park Guides, compiled by Professor Gilchrist for the Northumberland Education Committee. On these plots eleven different slags have been used, the analyses of which may be found in Tables 1 and 2. The analyses of the soils of the plots are given in Table 5 and the abstract of the crop of hay yielded in Table 6, fuller details of which are published in the Cocker Park Guides alluded to above.

The soils in these experiments varied from a fairly heavy Boulder Clay to a medium loam, but were uniformly poor in phosphates, not too well supplied with lime, and rich in humus. The crop was in most cases a permanent pasture mowed at the rate of 50 lb. of phosphoric anhydride (P_2O_5) per acre per annum, and in the other cases was a three years seeds hay mowed at the rate of 200 lb. of phosphoric anhydride per acre per three years.

For the purpose of calculating the coefficients of correlation, the departure from the mean weight of crop in any one year from two or three different slags was taken as " x " and the departure from the mean amount of any one constituent of two or three slags used to produce the above crop was taken as " y " in the formula given above.

The results so obtained are given in Table 1, where may be found not only the correlations of the constituents of the slags shown in Tables 1 and 2, but also the correlations of certain ratios calculated from the constituents. It will be at once seen that the coefficients of correlation are far less striking than those given in Table 3. The best are the ratios at the foot of the table. If, however, we consider, not the individual coefficients, but the general tendency of the coefficients, we shall obtain an accumulation of evidence. Percentage of phosphates, total, soluble, or insoluble, all show positive correlations, whilst the ratio, anything to phosphates, shows a minus coefficient. Generally speaking there is a uniform result, that is, right for and none against, that a high percentage of phosphates is a good thing to have in a slag. The results for lime are not quite uniform. The actual "citric solubility" of the slag shows only trifling positive results, though the percentage of citric soluble phosphates shows a better figure. If, however, we group results we find that all the four "constituents" depending upon extraction of slag by a 2% solution of citric acid agree in giving positive correlation, and thus we have cumulative evidence that the "citric solubility" methods of analysis have a general value, though we do not feel inclined on present evidence to consider any particular test as having a proved value.

As the actual returns of hay are expressed in terms of pounds per acre, it is desirable to know the results of the constituents of the slags also in terms of pounds per acre. Since the slags were applied in amounts such as were necessary to supply the same amount of phosphoric acid per acre, the actual weights of lime, etc., applied per acre will be in strict proportion to the ratios, lime, etc., to phosphoric acid; therefore the coefficients of correlation between the yield of hay and the pounds of lime, etc., applied per acre will be exactly the same as the coefficients of correlation between the yield of hay and the ratio $CaO : P_2O_5$, etc., as already given. Since, however, the percentage of phosphates in the slags has a positive correlation, any ratio which includes the reciprocal of the percentage of phosphoric acid is bound to be depressed and may very easily be actually minus, as occurs in the present case. These field trials were originally constructed to test whether slags with a high percentage of phosphates were better or worse

* This Journal, 1914, 33, 9.

TABLE 1.
Analysis of Basic Slag.

No.	1602.	1603.	2289.	2290.	2291.	2688.	3044.	3045.	3046.	3047.
Total P ₂ O ₅	12.60	20.49	18.03	9.00	12.55	19.58	17.69	17.57	19.34	19.01
Ca ₃ P ₂ O ₈	27.50	44.92	39.32	19.82	27.39	42.70	38.46	38.31	42.21	42.24
SiO ₂	17.60	10.12	10.12	13.49	13.51	13.75	7.85	7.77	12.18	12.12
CaO.....	38.02	16.81	14.04	40.43	46.58	46.63	52.00	52.22	45.61	44.45
MgO.....	4.24	2.92	3.56	5.01	2.47	2.21	1.88	1.94	0.16	0.11
MnO.....	7.30	4.38	4.54	5.41	3.61	5.70	9.37	9.37	4.26	4.08
Fe.....	12.89	3.98	12.97	13.83	10.19	8.88	8.13	8.13	3.03	3.10
V.....	0.48	0.66	0.45	0.23	0.24	0.33	0.32	0.38	0.34	0.30
Citric soluble P ₂ O ₅	19.01	14.39	13.36	0.01	11.67	14.58	15.58	15.78	15.42	15.74
CaO.....	21.91	31.45	29.16	13.11	25.59	31.84	33.95	31.49	33.61	33.86
Available lime.....	32.50	31.68	30.84	28.69	33.80	32.53	39.97	40.14	33.38	32.96
Citric solubility.....	2.03	11.62	15.04	21.59	19.97	15.27	21.50	21.63	15.29	14.01
Fineness.....	80	70	71	60	93	75	88	90	80	80
Fineness.....	85	88	90	95	90	90	78	77	82	84
Reducing power (H.O.).....	13.63	7.31	12.40	13.24	5.78	11.40	8.20	8.10	10.80	10.70

than slags with a low percentage of phosphates, when applied so as to give the same amount of phosphates per acre. The examination of these results shows clearly that the high percentage phosphates give the better results. When, however, we attempt to extract further information from these field trials so as to find out the values of lime, etc., we are met with the difficulty that the success of the experiment, from the point of view taken when the trials were designed, hides the effects of the other constituents of the slags and renders interpretation difficult.

The balance between the constituents of slags.—If the results just given are plotted, the data are too scattered to show much relationship, but curves may be drawn by arranging the data in order of the percentage of constituent below or above the mean and then averaging ten consecutive results. In most cases, such as those in Graphs 2 and 3, where any clear figure results, an optimum point is shown, and as a rule this optimum is not very far removed from the mean composition of slags as here published. It is hardly likely that the exact composition suitable for Cockle Park is also the best elsewhere, but the almost regular recurrence of an optimum point in the curves suggests that there is a certain balance needed in a slag. Probably a slag of medium composition is better than a slag of abnormal proportions.

Recent bacteriological research has shown that the balance of ions in solution is important in bacterial growth, and it seems not improbable that the rate of nitrification or some other bacterial process may be influenced by the balance of constituents in the slags. So far as we can judge at present, the average slag seems fairly well balanced. There is, however, no evidence that there is any particular constituent or property of slag, excepting of course the total amount of phosphates, that can be set apart as having an importance much greater than any other such constituent or property. Indeed, the evidence is all the other way. Very many of the constituents, such as magnesia, manganese, and iron, appear to have an influence and not merely a direct influence on crop production, but that the balance of these constituents is also important. Such a problem needs far more data than was anticipated when these investigations were commenced, but

TABLE 2.
Composition of Slags.

	2687.	2716.	2.
Total phosphate.....	37.60	29.07	41.3
Total lime.....	59.01	50.69	43.1
Citric solubility.....	95	80	80
Fineness.....	88	70	90

TABLE 3.
Coefficients of correlation between citric solubility and the constituents of slags.

Constituent.	Coefficient of correlation.	Probable error %.
Phosphates.....	+0.23	0.01
Silica.....	—0.37	0.10
Lime.....	+0.74	0.07
Magnesia.....	—0.31	0.12
Manganese.....	+0.17	0.14
Iron.....	+0.17	0.14
Fineness.....	+0.36	0.05

TABLE 4.
Coefficients of correlation between the yield of hay and the properties of slags.

Property of slag.	Coefficient of correlation.	Probable error %.
Phosphates.....	+0.13	0.09
Silica.....	—0.05	0.03
Lime.....	—0.06	0.01
Magnesia.....	—0.15	0.10
Manganese.....	0.00	0.10
Iron.....	+0.02	0.14
Citric soluble phosphates.....	+0.11	0.09
Citric soluble lime.....	—0.15	0.09
Available lime.....	—0.19	0.03
Citric solubility.....	+0.03	0.03
Citric insoluble phosphates.....	—0.10	0.03
Fineness.....	+0.01	0.01
Ratio CaO : P ₂ O ₅	—0.20	0.05
MgO : P ₂ O ₅	—0.26	0.10
MnO : P ₂ O ₅	—0.20	0.10
Fe : P ₂ O ₅	—0.25	0.10
SiO ₂ : P ₂ O ₅	—0.21	0.07
CaO : MgO.....	+0.06	0.10

TABLE 5.
Composition of soils.

	Maximum.	Minimum.	Mean.
Stones.....	11	0	2
Organic matter.....	11	6	9
Silica and silicates insoluble in hydrochloric acid.....	85	75	80
Soluble in hydrochloric acid:—			
Iron oxide and alumina.....	10	8	9
Lime.....	1.0	0.3	0.6
Polash.....	0.4	0.2	0.3
Phosphoric acid.....	0.12	0.04	0.07
Soluble in citric acid:—			
Lime.....	0.81	0.16	0.55
Potash.....	0.026	0.007	0.010
Phosphoric acid.....	0.015	0.002	0.009
Nitrogen.....	0.23	0.13	0.16
Calcium carbonate.....	0.42	0.004	0.01

TABLE 6.
Crops of hay obtained by manuring with different slags.

Experiment A.			
Slag.	1602.	1603.	
Year.	Cwt. of hay.		
1901	20.0	19.5	
1902	15.8	14.5	
1903	23.5	28.2	
1904	33.2	32.2	

Experiment B.			
Slag.	2290.	2289.	
Year.	Cwt. of hay.		
08	22.8	20.2	
09	26.5	25.2	
10	29.0	29.5	
11	14.0	14.0	

Experiment C.			
Slag.	2290.	2291.	
Year.	Cwt. of hay.		
02	20.2	26.8	
04	24.5	24.0	

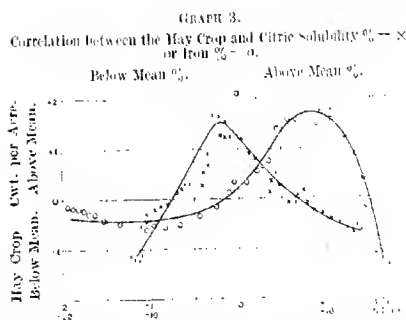
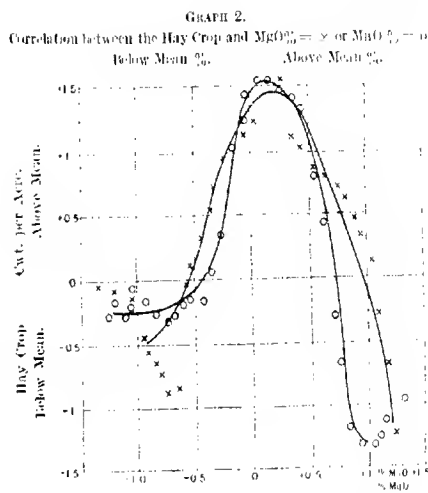
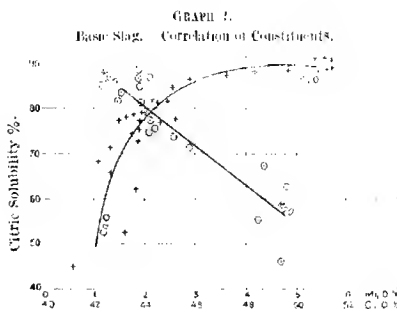
Experiment D.			
Slag.	2289.	2291.	2290.
Year.	Cwt. of hay.		
008	9.1	8.0	7.1
009	35.9	35.4	31.8
010	18.5	18.0	15.0
011	19.2	17.0	17.0
012	41.2	33.2	30.0
013	19.5	18.0	15.8

Experiment E.			
Slag.	2088.	2716.	2680.
Year.	Cwt. of hay.		
11	25.5	26.5	24.0
12	42.0	40.0	41.2
13	50.5	52.5	49.8

Experiment F.			
Slag.	2.	2290.	
Year.	Cwt. of hay.		
1912	55.2	39.2	
1913	48.2	50.0	

Experiment G.			
Slag.	3044-5.	3046-7.	2290.
Year.	Cwt. of hay.		
1913	43.5	44.2	43.5

the authors think that this knowledge is well worth having, even if incomplete. Experiments are still in progress, and as evidence accumulates it will be possible to discover more exactly what is the proper balance between the constituents of slags.



Conclusion.—It is quite well known that such substances as magnesia and manganese influence the cropping power of a soil, and it is known, though perhaps not appreciated, that these constituents vary considerably in slag. The most important constituent of slag is undoubtedly the phosphate, but in attempting to discover the constituents of secondary importance, the authors believe that no general investigation has been attempted, research having been restricted to one or two points. The wide attempt here made to find out the most likely ingredient to rank in the second place of importance, shows that even if these be all taken into account something more will be needed to give a fair presentation of the facts of the case. Not merely do many other

constituents appear to have a value, but there seems much reason for supposing that a balance of the secondary constituents is needed. In other words, medium proportions of magnesia, manganese, and iron are all useful, but extra large proportions harmful. The citric solubility of slags is correlated with the constituents of slags in such a manner that it may form a useful test, provided that its arbitrary and conventional character is recognised.

New England Section.

Meeting held at Boston, Mass., on Friday, March 19th, 1915.

MR. C. L. GAGNEBIN IN THE CHAIR.

FACTORS INFLUENCING THE STABILITY OF HYPOCHLORITE SOLUTIONS.

BY MARTIN L. GRIFFIN AND JOHN HEDALLEN.

The experiments recorded in this paper were carried out to determine the influence of various factors on the stability of solutions of calcium hypochlorite. For this study it is important to use exact methods for determining chlorine in its various forms. We have, therefore, reviewed and tested in this connection the most approved methods for doing this, which we believe will bring some fresh knowledge to this subject.

Bunsen's method.—A definite volume of bleach liquor is delivered into an excess of potassium iodide, acetic acid is added, and the liberated iodine titrated with sodium thiosulphate. This method gives the most accurate results and is a very rapid one. The only objection to it lies in the cost of potassium iodide and the somewhat unstable nature of the thiosulphate solution.

Penot's method consists in titrating a known volume of the bleach with an alkali arsenite solution, using iodide and starch as indicator. This method is not very well adapted to a plant where a number of titrations have to be carried out in a short time. Since the end-point is unknown it is necessary to take out a number of samples before the titration is completed, and finally, a check test has to be made in order to get an accurate result.

A modification of this method, by Mohr, consists in adding an excess of arsenious acid and titrating the excess with standard iodine. It has been claimed that these two methods work very well with solutions of chloride of lime, but that much trouble has been experienced in titrating the available chlorine in bleach made by passing chlorine gas into an excess of milk of lime, owing to the presence of free hydroxide, which would produce sodium carbonate when titrated with arsenious acid made alkaline with sodium bicarbonate. Further, it is claimed that the time factor will influence the titration results. We have not been able to verify any of these statements.

To examine the different methods mentioned for the determination of the available chlorine, a number of tests were made of electrolytic bleach liquor and of that made from bleaching powder with carefully standardised normal solutions. The comparative tests on the same sample were carried out at practically the same time, care being taken that conditions in each case remained the same. The same pipette was used in the same manner and the normal solutions were delivered into the sample to be tested at the same rate as when standardised.

To ascertain whether the amount of iodine used in Mohr's process had any influence upon the titration, the same sample was tested with 2, 5 and 10 c.c. excess arsenious acid.

The titration results with Penot's and Mohr's methods were in every case about 0.6% lower than those with the Bunsen method, and there was no indication that the electrolytic bleach liquor behaved differently from bleach liquor made from the powder.

The methods of Penot and Mohr in each case gave reasonably concordant results, and the amount of iodine introduced in Mohr's process was without influence upon the results.

We have further ascertained that the length of time used in titrating the samples is without influence, provided proper correction is made for the adhesion of the normal solution to the burette.

The method used for the analysis of a mixture of hypochlorite, chloride, and chlorate is that described in Sutton's "Volumetric Analysis" (10th ed., p. 178). The process is at once expeditious and accurate. All the determinations are performed successively upon the same solution.

In the daily bleach plant analysis, it is hardly necessary to determine the chloride and chlorate separately, since it is only necessary to know the availability of the liquor or the relation between the available and total chlorine. The method can therefore be shortened as follows:—Pipette 5 c.c. of the liquor to be tested into a pressure flask and add about 25 c.c. of a solution containing 40 grms. per litre of ferrous ammonium sulphate and 40 c.c. of sulphuric acid. Heat to about 100° C., cool slightly, and then add the silver filter, wash the precipitate, and titrate the excess silver with thioeyanate as in the original process. The available chlorine is determined in a separate sample by the Bunsen method.

In the manufacture of calcium hypochlorite a certain excess of base must be present, otherwise the bleach liquor will chlorinate at once, producing a colourless or pink liquid according to the degree of chlorination, the pink colour being due to manganese.

In laboratory experiments 5% excess base will, as a rule, give a perfectly stable liquor with an availability of about 98% even after three days standing. In practice a larger surplus is required because, on a large scale, it is difficult to keep the concentration of the base and the volume of the feed regular, and as much as from 25 to 30% excess is ordinarily used. This excess of lime separates from the liquor upon standing, and is called sludge. In the following tests, approximately 10% excess base has been used, calculated on the total chlorine in the liquor. The availability obtained with lime alone as a base is taken as a standard in comparing the results.

Lime sludge.

The considerable excess of lime used in the manufacture of calcium hypochlorite can be used over again to advantage under certain conditions. It differs from fresh lime in that it does not possess the same ability to form a stable hypochlorite, though the excess of calcium hydroxide is the same. This is mainly due to the impurities.

The following analysis gives the relative composition of lime and its corresponding sludge.

	Lime.	Sludge.
	%	%
CaO	96.5	81.0
MgO	1.0	5.5
Fe ₂ O ₃ , Al ₂ O ₃ , SiO ₂	2.5	13.5

To determine the effect of sludge upon the availability when used over again for the manufacture of hypochlorite several tests were carried out with varying amounts of sludge and fresh lime as a base. The free calcium hydroxide in the sludge used was determined gravimetrically. The results are given in the following table, from which it may be seen that in the first four tests respectively 100, 75, 50, and 25% sludge was used in conjunction with 25, 50, and 75% fresh lime.

Availability of bleach liquor solution with varying amounts of sludge and fresh lime milk.

Base.		Available chlorine (grms. per litre.)					Total chlorine (grms. per litre.)	
% Sludge.	% Lime.	Total Ca(OH) ₂ (grms. per litre)	% Excess.	Time made.	After 1 day.	After 2 days.	After 3 days.	
100	—	33.0	10.7	20.20	2.72	2.06	1.65	28.60
75	25	32.9	11.1	22.45	2.97	2.31	1.98	28.39
50	50	32.5	12.4	24.22	4.75	2.56	2.14	27.70
25	75	32.0	13.5	26.61	26.35	26.35	26.22	27.08
100	—	52.2	81	26.45	26.46	26.45	26.42	27.72
83	17	47.2	63	27.60	26.85	26.56	26.50	27.44
62	38	42.1	47	26.95	26.45	26.95	26.85	27.55
62	38	42.1	36	30.50	30.45	30.40	30.40	31.10
35	65	37.2	21.6	28.18	28.15	28.12	27.95	28.80

It will be seen from the table that the bleach liquor is unstable with sludge alone and with 75 and 50% sludge when the excess base is only about 10%. All of these samples turned pinkish shortly after being made, and after three days standing 16.5% of the total chlorine had been converted into chloride. The fourth sample with 25% sludge and 75% new lime gave a stable liquor of 96.8% availability after three days standing. These results correspond to what we have found in practice.

These tests were repeated with the same amount of new lime but with a more concentrated sludge. In this case we found, as shown in the table, that sludge alone, as well as 75 and 50% sludge, will give a bleach liquor of a fairly high availability when well protected by an excess of calcium hydroxide, even in the form of sludge.

Influence of aluminium, magnesium, and iron hydroxides.

The impurities occurring in ordinary lime are aluminium, magnesium, and iron oxides; silica may be left out of consideration in this connection. To determine to what extent these impurities affect the availability of hypochlorite solutions, varying amounts of each were added, as freshly precipitated hydroxide, to the lime milk and the results noted on each of three succeeding days. The impurities added in each case were 2, 5, and 10 grms. of hydroxide per litre, the calcium base used being equivalent to 32.1 grms. per litre of Ca(OH)₂. Chlorine was led into these mixtures until the excess of calcium hydroxide remaining was approximately 10%.

Considering first the influence of aluminium hydroxide, we find that as much as 2.0 grms. per litre is without influence upon the stability of the liquor in the presence of 10% excess calcium hydroxide. Neither will an amount of 5 grms. per litre affect the availability, provided about 10% excess base is left; however, in the case of 5% excess calcium hydroxide, the availability drops rapidly, leaving only about 18% of the chlorine as hypochlorite after three days standing. The solution is stable with as little as 5% excess base in the absence of impurities.

In the case of 10 grms. per litre of aluminium hydroxide the availability is noticeably affected. Thus with 13% excess base, the availability was

95.4% after three days, and with 8.5% excess, the available chlorine was reduced to about 20% after three days. These experiments go to show that the influence of aluminium hydroxide largely depends upon how well the liquor is protected by the alkaline calcium base. Further, when as much as 10 grms. per litre of this impurity is added it will depress the availability of the hypochlorite solution even in the presence of a large excess of calcium base.

The magnesium hydroxide was added as Phillips' milk of magnesia. It has no influence upon the stability of calcium hypochlorite solutions in the presence of about 10% excess calcium hydroxide. On the other hand it does not replace the calcium as a base; thus in the presence of 10 grms. of magnesium hydroxide per litre with an excess of calcium of only 0.5%, the availability dropped to 37.6% after 3 days.

Ferric hydroxide, on the other hand, even in small quantities, rapidly reduces the availability of the calcium hypochlorite solution, leaving a pinkish liquor; its influence is proportional to the amount added.

Stability of hypochlorite solutions with alkaline earths, alkali metals, and magnesium hydroxide as a base.—The bleach liquor samples in these cases were made in the same way as the previous ones. The temperature of the base, the concentration of the liquor, and the excess alkalinity were the same for each test. Both the alkaline earths and the alkali metals gave practically equally stable hypochlorite solutions, with an availability above 98% after three days' standing.

The stability of the liquor obtained by leading chlorine into magnesium hydroxide (Phillips' milk of magnesia) is quite dependent upon the excess of free alkalinity. Thus, in the first test, where only half of the alkalinity was used up, 75.5% of the total chlorine was present as hypochlorite after three days, while in the second test, where only 26.5% of the total base was left as free alkali, the availability dropped rapidly to 7.9%.

As a rule, it can be said that in leading chlorine into magnesium hydroxide under the same conditions as in the case of calcium hydroxide, the hypochlorite at first formed will change rapidly to chloride and chloride with about 16% of the total chlorine present as chloride.

Bleach liquor made with magnesium lime as a base.—To show further the effect of magnesium hydroxide upon the stability of calcium hypochlorite solutions, a number of tests were repeated with ordinary magnesium lime containing calcium and magnesium in the proportion of 60 to 10, besides impurities to about the same extent as in the calcium lime used in these tests.

Stability of hypochlorite solutions with magnesium lime as a base.—In the first series of tests the total alkalinity of the base used was equivalent to 34.42

grms. of calcium hydroxide per litre, with an actual amount of calcium hydroxide of 18.5 grms. per litre. The first three samples gave a stable liquor of about 98% availability, since they contained a large excess of calcium base. In the three last samples the total chlorine exceeded the alkalinity of the calcium present; the availability of all of these samples dropped rapidly to about 7% after three days' standing.

A second set of tests was repeated with the object of determining more closely the relation between the excess calcium and the availability of the bleach liquor. When the total chlorine was equivalent to 90% of the calcium present the liquor was perfectly stable, while with 4.8% excess calcium base the liquor was stable for only one day, after which the availability dropped about 5% a day. Moreover, when the total chlorine was just equivalent to the calcium base the availability dropped regularly about 5% a day. In going beyond this limit the depression of the availability increased more rapidly.

In these two series of tests the calcium base used was only about half of what it had been in the previous tests with calcium lime as a base. A third set of tests was therefore carried out with magnesium lime. The total alkalinity of the base was 61.5 grms. per litre expressed as calcium hydroxide. In the first two samples the excess calcium was 10 and 5% respectively, and the availability of the bleach liquor 98% after three days. In the next sample a trifle more chlorine

2. The magnesium hydroxide sustains the stability of the hypochlorite solutions to some extent when the excess calcium is between the limits of 0% and 5%.

3. Even a large excess alkalinity in the form of magnesium hydroxide is incapable of maintaining the stability of calcium hypochlorite when the calcium is exhausted.

4. The absorption of chlorine after the calcium is consumed is very incomplete.

5. When leading chlorine into a mixture of calcium and magnesium hydroxides no magnesium will go in solution before all of the calcium is exhausted.

In order to make this work more complete similar experiments were carried out using small amounts of all the elements of the iron group, including iron, chromium, manganese, nickel, and cobalt. In each case the bleach liquor was very unstable, even when well protected with an ample excess of calcium hydroxide.

Effect of temperature and concentration upon the stability of hypochlorite solutions.

To determine the influence of concentration upon the formation of hypochlorite and the stability of solutions of high density, chlorine was led into a suspension of calcium hydroxide of 172.6 grms. of Ca(OH)_2 per litre until a concentration was reached of 105.5 grms. of total chlorine per litre, leaving 9.9% excess base.

Effect of temperature and concentration upon the availability of bleach liquor solutions.

(A). Concentration.

Base.		Strength of liquor.		Available chlorine (grms. per litre).			
Ca(OH)_2 used (g. p. l.).	% Excess.	Total chlorine (grms. per litre).	Time made.	After 1 day.	After 2 days.	After 3 days.	
172.6	9.9	150.5	147.88	146.00	146.20	145.00	

(B). Temperature.

Base.		Temperature, ° C.	Total chlorine (grms. per litre).	Available chlorine (grms. per litre).			
Ca(OH)_2 (g. p. l.).	% Excess.			Time made.	After 1 day.	After 2 days.	After 3 days.
31.7	11.7	30	27.20	26.99	26.96	26.96	26.90
31.7	12.21	35	27.65	26.81	26.80	26.80	26.76
31.7	11.5	40	27.30	26.90	26.82	26.82	26.78
31.7	9.4	45	27.80	27.30	27.30	27.22	27.22
31.7	6.3	50	28.60	28.60	27.98	27.98	27.98
31.7	4.2	55	29.20	28.55	28.53	28.52	28.52
31.7	10.0	60	27.62	27.60	26.96	26.96	26.90
31.7	7.9	70	28.15	27.42	27.42	27.40	27.40
31.7	8.6	80	28.00	27.30	27.21	27.20	27.19
31.7	11.3	90	27.30	26.50	26.42	26.42	26.40

was led than corresponded to the alkalinity of the calcium present. This sample soon turned pinkish and the availability fell rapidly to 12.1%. In the other samples the total chlorine was gradually increased until the excess alkalinity dropped to 10%. The samples turned pinkish as they were made and smelled strongly of chlorine. The liquor proved very unstable. After three days the pinkish coloured samples contained 15% of the total chlorine in the form of chlorate.

The effects of magnesium upon hypochlorite solutions may be summarised thus:—

1. The magnesium hydroxide has no effect upon the availability of calcium hypochlorite solutions provided the liquor is protected by at least 5% calcium base.

The availability of this liquor as made was 98.2% and after one, two, and three days respectively, 97.5, 97.2, and 96.3%.

From these results it appears that the concentration of the liquor has very little effect upon its stability. Stable bleach liquor of lower densities is usually greenish in colour, while at a high density it is yellowish. Bleach liquor of course settles more slowly with increasing concentration.

The effect of temperature was next examined by leading chlorine into calcium hydroxide at varying temperatures, starting at 30° C., and increasing the temperatures by 5° up to 60° C., then increasing the temperature by 10° up to 90° C. The table shows the temperatures of the finished liquor.

The chlorine was led into the base at such a rate that the sample was finished in half an hour. The total chlorine and the excess base were in each case about the same.

From the table on the preceding page it is seen that even high temperatures have very little effect upon the availability, it being decreased only 2.2% by raising the temperature from 30° to 90° C.

Nottingham Section.

Meeting held at Nottingham on Wednesday, March 24th, 1915.

MR. JOHN WHITE IN THE CHAIR.

THE EDUCATION OF THE INDUSTRIAL CHEMIST OF THE FUTURE.

BY R. M. CAVEN, D.SC., F.I.C.

I prefer to speak of the education rather than of the training of the future industrial chemist. So far as a distinction can be drawn between the two things, education develops incipient faculties, while training shapes mature powers. A trained man does what he is trained to do; an educated man brings an alert mind to new problems.

In the first place I would advocate breadth of view. A good part of the education and training of the industrial chemist is identical with that of other professional chemists.

For years to come a German training will be out of the question. This circumstance affords a splendid opportunity for our educational authorities to supply the lack, and to supply it so efficiently that nothing shall at length be lacking. The universities must realise the magnitude of their task, and, what is more important because more difficult, the British public and manufacturers must learn the meaning and value of scientific education.

No young man can learn to be a professional chemist by attending evening classes at a technical college after his day's work is done. A youth must give his best time, all his available time, to be educated for the profession.

Dignity must be added to the popular conception of the professional chemist in the future. When the importance of the work he can perform, and the extent of the education and training which will be required to fit him for that work, are fully recognised, then, it may be hoped, adequate remuneration for his services will be forthcoming.

The preliminary education of the future professional chemist should be liberal and good, and should include as a minimum a grounding in English, Mathematics, French, and German, if not Latin; early specialisation should be shunned like poison. My own very pronounced opinion is that instruction in elementary physics and mechanics should precede the teaching of chemistry, for the theoretical foundations of chemistry are laid in physics, and, to a less degree, in mechanics. It will be time enough for a lad's liking for chemistry to show itself during the last year or two years of his school course. No harm will be done if he proceeds to the university with a general love for science which has not yet expressed itself in the direction of chemistry. If, however, an early predilection for chemistry is encouraged at the expense of other studies the effect will undoubtedly be harmful.

When the chemistry student enters upon his college career, the important question arises as

to the fundamental principles that are to underlie his education and training. The easiest way for the teacher to go to work in class room and laboratory is to tell the student what he is to learn, and then see that he learns it, or to inform him what he is to do, and make him do it.

This is training without education; it is the method of the drill sergeant. It may be successful in forcing students through examinations, it certainly will be successful in killing originality and independence of thought, in turning students into automata, and making it impossible for them to become the industrial chemists of the future. Another way is to cause a student to embark on a voyage of discovery in unknown seas, without helmsman or pilot, in the hope that by long and perhaps bitter experience he will at length learn the principles of navigation, and succeed in steering his ship to port. This way is very likely to end in distress and eventual shipwreck; it is as little to be commended as the former way. A judicious combination of the two ways is the safest method of teaching.

Facts must be imparted to the student; he cannot discover everything for himself along the pilgrim way of the pioneers; yet the spirit of inquiry must be awakened in him from the first and kept active through his whole career. The easiest way to kill this spirit of inquiry is to overload the student with facts. Facts must be co-ordinated. Un-coordinated facts are best left in the text-books and chemical dictionaries until a use is found for them.

The same principle applies to the student's practical work. It has been a reproach of the teaching of qualitative analysis that the student's memory is filled with a pile of facts and directions which grows to alarming dimensions and has little, if any, educational value. These facts are often presented to the student in such a way that he gains no insight into the principles on which the group separations depend; and when he uses the analytical tables to "do salts," as he says, he employs them in an unintelligent way, with little true knowledge of the significance of what he is doing. Thus the chance of his becoming an intelligent analyst is jeopardised from the first, and the likelihood of his developing into a first rate research chemist is reduced to a minimum.

If a student is intelligent, and is being taught in the right way, his practical work should give rise to all sorts of questionings about chemical processes and reactions; and he may even propose to his instructor alternative methods of procedure. The idea may be very foolish, or it may be wise, and capable of development into something valuable. In any case the instructor will, if possible, answer the proposal with the injunction: try it. He is either a very stupid, or very inexperienced teacher who has never learnt anything from his students. Zealously to watch for, and wisely to nurture fruitful ideas should be amongst the most important responsibilities of the chemistry teacher of the future.

What is useful above and beyond all things else is an alert mind possessed of a scientific culture, a culture based on a broad and sure foundation of fundamental scientific principles. A man with such a mental equipment will discover principles where another man will merely observe, and perhaps imperfectly observe, phenomena. Such a man may have many failures in his early attempts to extend the bounds of our knowledge of chemical science, and to invent or improve processes of chemical manufacture; but these failures he will be content to regard as a preparation for eventual success.

It appears to me that whilst the industrial chemist should be thoroughly grounded in inorganic and organic chemistry, he should pay

particular attention to physical chemistry. For it seems that, except for the production of synthetic drugs, dyestuffs, and other organic substances, future advance is likely to be along the lines of the improvement in the preparation of known substances rather than the synthesis of new ones, and this will result from the novel application of recognised physico-chemical principles to known chemical reactions.

Perhaps the most important question to be faced in the final stages of the student's course is as to how far definite instruction in chemical technology should be attempted. If a student is to become a works chemist, it may be asked, should he not learn something about the construction and use of chemical plant while he is at college? It is true that he makes a superficial acquaintance with the elements of metallurgy and the methods of manufacture of acids, alkalis, and other products in an ordinary course of lectures; but is this enough? Should our universities and technical colleges lay themselves out to reproduce on a working scale models of the plant employed in representative processes of chemical manufacture, such as iron and steel making, the production of acids and alkalis, or the elaboration of coal tar products? One is tempted to ask at the outset how such a thing could be done, and also whether it would be of permanent value if it were done? Would not such working models soon be out of date? Would it be possible to keep pace with the improvements in and additions to chemical plant coincident upon advances in methods of manufacture?

Even if such a thing were attempted would it not go contrary to the methods of teaching I have tried to enunciate? These methods should concern themselves with principles rather than details. I can well believe, however, that a valuable course of lectures relating to chemical technology might be devised in which chemical reactions and the principles underlying them would be carefully classified and elucidated, and their application to modern processes of manufacture made plain. Such lectures might perhaps be accompanied by small scale experiments, here and there, and would be abundantly illustrated by diagrams of actual chemical plant.

Then I think that the final stages of the student's course might include some instruction in machine drawing and the principles of chemical engineering, as well as in metallography, and perhaps some practice in metallurgy.

It will no doubt be held by some that, since professorships of economics and commerce are being established in university centres, the future industrial chemist should avail himself of the facilities thus afforded for commercial training; though upon this question I cannot pronounce any opinion.

But, whatever courses of instruction are included in, or omitted from the student's curriculum, one thing should be kept ever in view: to develop power of initiative and resource, in view of new requirements and new opportunities, so that the coming industrial chemist may play a worthy part in the shaping of the future.

DISCUSSION.

Mr. F. H. CARR agreed that the most important thing needed by the industrial chemist was resource, which could only result in the brain that had been trained to alertness and in the habit of thinking on scientific lines and in a scientific way. Often the mental equipment of the so-called best trained men fell short of much that the college might have given them, and he thought one could detect that in the general attitude which manufacturers in this country took towards the chemist.

When a young man entered a works he was generally made to analyse, and the manager was anxious to protect his business from any foolish thing that this scientific person might promulgate. A fully trained chemist emerging from college, having only gone through a technical training, had to be some time in business, both in the factory and on the business side, in order to gain sufficient knowledge of the commercial aspect. The consequence was that the college student was not at first a very suitable person to advise on business matters and the result was that he was kept to analysis. For a post-graduate course he advocated a course of training in which the student was taught to carry out practical operations from the purely commercial aspect, to ascertain how to obtain the right yield of a product in a minimum of time, and to control a reaction when working first on a small scale and then on a much larger scale. He ought to learn to do the analytical work with a view to speed and accuracy, and he should get an insight into the principles of accountancy and costing. The only way to secure these things being taught would be to establish classes in a limited number of colleges where the actual manufacture of certain chemicals was undertaken. His proposal was to manufacture and sell those compounds, chiefly organic, which we had been accustomed to purchase from Germany, confining the field to those chemicals used in our colleges and for which there is no competition and no significant commercial demand. The colleges would supply these products through one institution: the products would be of a kind most difficult to make, the cost of every batch would be ascertained, and they would be subjected to public criticism, because they would be sold. In the course of twelve months a student would learn a great deal of practical manufacture, so that when he got an industrial appointment he would better be able to help his employer.

Mr. SMITH said that the commercial training of the chemist was a very difficult subject because there was the jealousy of the commercial man to contend with. The average commercial man learnt by association with the firm and learnt very easily indeed. The wonderful principles of finance were very simple, and any man with a chemical training would quickly learn them. The jealousy of the commercial man was the stumbling block in the way of the chemist.

Mr. J. T. WOOD said he was sure that genius could not be inculcated at any course of lectures. It was essential to have the right material to work on.

Mr. S. J. PENTECOST said he had always been surprised that the commercial aspect of industrial chemistry had not been taken up by their own City Corporation in relation to the gas undertaking. They had entirely neglected to deal with by-products, and it had always seemed a great pity that they had not arranged a research laboratory in connection with that industry. They might have gone a long way towards solving the difficulty as regards basic products for use in the manufacture of aniline dyes.

The CHAIRMAN thought the whole crux of the matter lay in the attitude of the manufacturer towards the chemist. He regarded the engineer apparently as a man who could show something by his work. He valued his commercial staff because they showed him exactly what profit or loss he was making. He regarded the chemist with contempt because he could sometimes only show a small result from arduous, honest, and prolonged work. As to the idea of making the chemist an engineer, an accountant, and a commercial man generally, he asked, when will he begin to earn his living? The ordinary span of life was not sufficient for all those.

THE EDUCATION OF THE INDUSTRIAL CHEMIST.

BY E. B. R. PRIDEAUX, M.A., D.SC.

Two logically distinct kinds of education, which may be called the "Technical" and the "University," are usually blended in existing institutions, whether these are called technical Colleges or universities. Under the technical system a student ranges through a wide variety of allied subjects and is given as concisely as possible a selection of those facts and methods which have been proved to possess the highest utilitarian value. Under the university system the student after the liberal training of a pass degree makes an intensive study of, say, two allied sciences with full comprehension as an aim. While the technical system is well exemplified by many schools of engineering, the difficulties of applying it in chemistry are notorious. The Massachusetts Institute of Technology may serve, however, as an example. The student is trained in all necessary kinds of calculation and drawing, and has also gained experience in such processes as the electrolytic production of aluminium or the smelting of ores in small-scale shaft furnaces, after a full course in institutions of this kind. The graduates may also be in possession of manufacturing "tips," they are at home with machinery, and possess a great deal of knowledge which is likely to be immediately useful in the routine of management of many different industries. It may be asked, what more can the manufacturer require than a compendium of immediately practicable information? And indeed, men of ordinary ability trained on these lines, are well fitted to form the backbone if not the head of industrial chemistry. If their energy and initiative is beyond the normal, they also succeed in making a mental synthesis of a mass of information which was not mainly selected with a view to forming a coherent system of knowledge. Since this kind of success, however, is difficult to attain in the full tide of business, and is not specially demanded by the employer as a rule, it will in practice only be secured before a man's life-work is begun. The defect of the "technical" system is that it hinders rather than helps such an early mental synthesis. The scientific industries of the country require for their guidance and furtherance a certain proportion of men who have taken special care to train their scientific imagination. It is the proper business of the university to supply these. The typical University student has a strong theoretical bias and a love of knowledge for its own sake. If the goal of the typical technical college is sufficient grasp of the subject to enable a man to handle ordinary situations, the goal of the university is the fullest comprehension of which he is capable. The whole training, ending with a year of research, should give him such an intensive grasp of the principles of the science, and of the methods of advancing knowledge in one branch, that he will be able to undertake investigations in other branches of which he has had no concrete experience.

This is what the university-trained man has to offer to his employer in place of an elaborate training in technical methods. He is complementary to the technical graduate. Unlike the latter, he is often slow to "make good," but his education has made it easy for him to follow the developments of science and apply them to his business, which may thus hold its own in competition with those of other countries where the value of developing and using the theoretical type of mind is better understood.

The education in the post-graduate year is limited by the available staff and apparatus, and upon these will depend the nature of the research undertaken. There should be a tutorial relation

between teachers and students, so that different aspects of each research problem may be discussed both informally and at a periodical colloquium.

With regard to the choice of apparatus, there appear to be some definite criteria which must be observed in all institutions which do not possess unlimited funds. In the first place it will perhaps be accepted that a good deal of the special apparatus for research should be designed and put together by teachers and students, using as far as possible ordinary laboratory stock. A liberal petty cash allowance which may be spent locally on felt, telephone wire, sheet iron, etc., is also indispensable for this purpose. Compact and portable instruments may be bought if they are relatively inexpensive and easily obtainable in this country. Thus a student need not attempt to make an ammeter but should set up his own capillary electrometer. The provision of expensive apparatus depends of course upon the liberality of university and local authorities or local benefactors. Such apparatus should fulfil the conditions of being difficult or impossible of construction by an amateur, and of permanent value for increasing scientific knowledge. Thus a calorimetric bomb or a small autoclave is a good investment, while a model automatic Sprengel pump would be an extravagance in most cases.

A complete and compact direct reading thermoelectric pyrometer is a necessity in a modern works requiring temperature control. But if a research student wishes, *e.g.*, to take cooling curves of alloys or mixtures of fused salts, he may be supplied with the materials for a base-metal thermo-couple and an ordinary potentiometer bridge. With these he will gain an intimate knowledge of the advantages and defects of one of the most important tools of the modern works chemist.

A preliminary knowledge of the methods of determining hydron concentration, the heats of chemical reactions, the electrolytic conductivity of solutions, etc., will no doubt soon form an essential part of an Honours course in all universities. These methods, included under the name "physical chemistry," will then be used in attacking the problems of academic research, and will finally be employed with confidence in technical investigations.

The choice of a research is guided mainly by the preference of the student and the previous knowledge of the teacher. Few, even of teachers with comparatively large leisure, can be expected to have more than a few "lines" of research properly opened up. These are sufficient, as in most cases the research is suggested by the teacher. For various reasons problems of technical interest are difficult to obtain, and sometimes they have not the necessary scientific interest and relation to existing and proposed theories. Thus a mere investigation of the best proportion of sulphur to produce a given vulcanised product is not suitable, whereas the investigation of the molecular states of the constituents, or of a neat method of analysis might afford good subjects. A young man also has a right to expect that a problem not of his own choosing shall yield some definite results. These conditions being fulfilled, is it necessary that the research shall have any definite connection with probable future work?

The answer that is given to this question will be all-important in shaping university policy. If it can be proved possible to produce a general power of chemical investigation by means of a specific research, then any suitably staffed institution of university standing, without special equipment, will be able to play an important part in training the officers of the army of production. The educational theory of "formal discipline" states that all faculties can be trained by means

of certain selected subjects, notably the traditional classics and mathematics. As applied to school subjects and boys of school age this theory is somewhat discredited. But the branches even of a subject so large as modern chemistry are related to one another more closely. Also a graduate, unlike a school-boy, can apply skill gained in one department to another department. Those who do not become mentally adult in this sense would benefit more by a specific vocational training. But the scientific organiser of industry (who may perhaps at some future date be allowed a voice in the management equal to that of his business colleagues) needs chiefly a fine judgment in selecting from the mass of facts and theories, combined with a practical skill in devising ways and means for attacks upon new problems. This can be gained by suitable research of any sort. For example, the principal type of research at University College, London, was formerly that which involved the preparation and purification of gases, and the manipulation of these at low temperatures. The lessons gained in this kind of research have been successfully applied by the graduates to the most varied kinds of industrial problems.

DISCUSSION.

Mr. CARR did not agree that even simple problems such as the conditions of vulcanising rubber were not suitable subjects for scientific technical research. Many simple processes could be improved if only people of thoroughly scientific training were employed in patiently investigating them. Such problems would teach the student to enquire himself and to wrangle with difficulties. Great attention should be applied during the finishing course at college to disciplining the mind to deal with practical problems. It was the energy which the exercise of this discipline brought out, which was one of the very important points in a man's training.

Mr. WILKIE considered that one of the greatest needs for university and college research was enthusiasm. Enthusiasm expended upon carefully selected, suitable subjects was of more value than anything else. That was one of the points where our research centres seemed to lag behind those of Germany. Leeds University had one of the best colloquiums he had heard of, where the professors of chemistry and the allied subjects of engineering met the students and discussed the researches they themselves were undertaking and intended to undertake, and compared the results with those of the same type being undertaken in the continental universities. If industrial chemists could be successfully trained by undertaking researches in rare gases, there would be more enthusiasm developed in researches which were more directly connected with a larger field of industry.

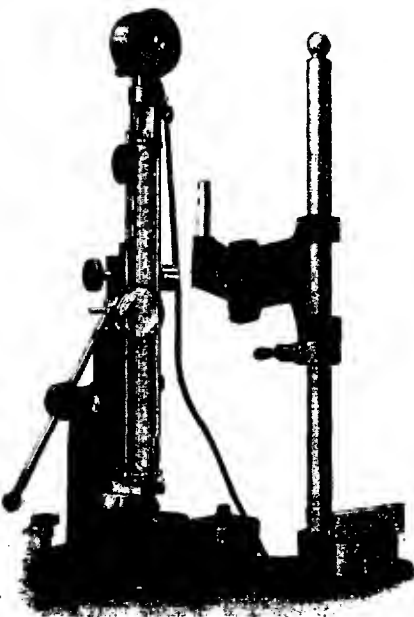
Professor BULLEID said he had been struck with the limited outlook of a number of chemists he had met in works in the application of science to problems outside those with which they were immediately connected, and their lack of appreciation of the all-round nature of a big problem, of which the chemical analysis might be only one small part. He impressed upon his students the fact that they could not afford to neglect anything. He dwelt upon the value of training, the idea of setting out to find something new, devising methods, collecting results, etc. The difficulty with the student who was setting out to do research work was first of all that he must know the problem given to him. The practical thing was for him to find his own problem, to put the question to himself: "Can this be improved?" When a man had been able to find his own problem

he would be prepared, when he got into a works, to experiment. The student ought to devise his own methods and meet his own difficulties, and only fall back on the teacher in the end. He must be expected to blunder, but if he blundered on until he finally succeeded he was a much better man when he got into the works.

The CHAIRMAN said he wondered why a chemist should always be required to know a good deal about other sciences. No living chemist was an authority on every branch of chemistry, and he wondered what type of man it was that was to be able to take up all kinds of research work, that was also to be able to perform accurate analyses with speed, and was also to have a fairly wide knowledge of all kinds of abstruse engineering problems.

Mr. COLLITT mentioned that Sheffield University provided quite as good a training as the continental one Dr. Prideaux had mentioned. He did not think there was a university in the world which gave such a good metallurgical training. He was inclined to ask whether the chemist of the future was going to spend the greater part of his time in the laboratory or in the works. If in the steel or blast works he did not seem satisfied to remain a chemist. The reason was lack of proper remuneration. His position as a chemist had never been properly valued.

Dr. PRIDEAUX, in reply, urged that the best incentive a man could get was a scientific interest in a problem. If a man in a works had a theoretical problem to investigate he would see the business aspect of it fast enough in the interest of his employers. The best thing would be to follow a university training with two years in a technical high school, but that course was too long and expensive and therefore they had to fall back upon practical politics, at all events in England.



The Shore Scleroscope.

Mr. BERNARD COLLITT gave a description of the Shore Scleroscope, and demonstrated its use. It is particularly useful in gauging the hardness of case-hardened steel parts. Briefly, the instrument consists of a small hammer, the striking face of which is a diamond. The hammer is allowed to fall a certain distance (about ten inches) down a vertical glass tube on to the material to be tested. At the back of the glass tube is a scale divided into 140 divisions, the figure of 100 representing a well hardened tool steel. After striking the material under test, the hammer rebounds and the height of rebound as read off on the scale at the back of tube is the hardness number.

An illustration of the instrument appears on the preceding page.

Obituary.

C. A. R. TENNANT.

Second Lieutenant C. A. R. Tennant, who was killed near Ypres on May 9th, was educated at Eton and afterwards entered the firm of C. Tennant, Sons, and Co., 9, Mincing Lane, E.C. For some years he had been in the Montreal branch of the firm, but at the outbreak of war he returned to England and enlisted in the London Scottish. In January he was given a commission in the 3rd Dorsetshire Regiment and left for France in March, attached to the 2nd Devonshire Regiment.

Journal and Patent Literature.

PATENT SPECIFICATIONS may be obtained by post by remitting as follows:—

English.—6d. each, to the Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

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I.—GENERAL PLANT; MACHINERY.

Solar energy; Utilisation of.—A. S. E. Ackermann. J. Roy. Soc. Arts, 1915, 63, 538—565.

THE history of the subject is outlined briefly and special reference made to investigations culminating in the establishment of the Shuman-Boys sun-power plant at Meadi, near Cairo, during 1912 and 1913. This apparatus consists of five parallel units arranged with their axes N and S and mounted so as to "follow the sun" automatically. Each unit, 205 ft. long, is composed of a boiler placed on edge in a channel-shaped reflector of parabolic cross-section; and each boiler, placed at the focus of its reflector, is surrounded by an air space enclosed by a single thickness of glass. The total area of sunshine collected is 13,269 sq. ft., the concentration effected by the reflectors being $4\frac{1}{2}$ to 1. In an extended series of trials made with this plant, the maximum quantity of steam produced was 12 lb. per 100 sq. ft. of sunshine per hour, i.e., 183 sq. ft. of sunshine per brake horse-power (1 b.h.p. = 22 lb. of steam at atmospheric pressure); the maximum thermal efficiency was 40.1% (solar constant = 7.12 B.Th.U. per sq. ft. per min.). In the best one-hour run, 1442 lb. of steam at atmospheric pressure was produced. The utilisation of solar energy is regarded as almost a solved problem where sunshine is plentiful and coal only obtainable at £3 10s. per ton.—W. E. F. P.

PATENTS.

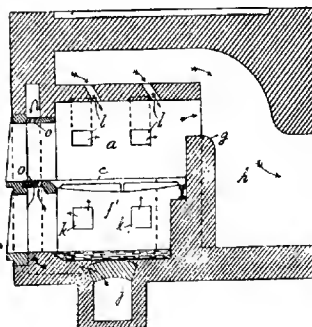
Drying cylinders; Construction of steam-heated.—H. Smith, and Mather and Platt, Ltd., Manchester. Eng. Pat. 8401, April 3, 1914.

In steam-heated cylinders for drying continuously textile or other goods, the ends are formed with slightly conical flanges which fit into the cylinder shell, the ends of which are also slightly tapered, so that the joint is kept tight by the internal pressure. Rings of corresponding shape are forced on to the ends of the cylinders to strengthen the joints. Special means are provided for ensuring a tight joint between the hollow trunnions and

the cylinder, and between an air or vacuum valve and the cylinder. To collect condensation water, troughs are arranged along the sides, converging towards one another at one end and discharging into a collecting chamber which delivers into the hollow trunnion.—W. F. F.

Furnaces for supplying heated air and gas employed in drying processes. The Staveley Coal and Iron Co., Ltd., and C. P. Markham, Chesterfield. Eng. Pat. 20,232, Sept. 26, 1914.

Low-GRADE fuel is burned in the closed combustion chamber, *a*, provided with a grate, *c*, and a closed ashpit, *f*. Air enters through the flue, *g*,

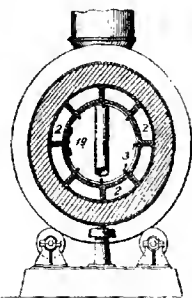


and circulates through the hollow walls of the combustion chamber. Part enters the ashpit through the ports, *k*, *k*, and serves as primary air for combustion; part enters the fire-door through the slots, *o*, *o*, for the purpose of preventing the door becoming overheated; part enters the combustion chamber through the ports, *l*, *l*, and serves as secondary air for combustion; and part mixes with the products of combustion, which enter the conduit, *h*, through the port, *g*.—W. H. C.

Drying apparatus. G. H. Hagan, Pittsburgh, Pa. U.S. Pat. 1,126,197, Jan. 26, 1915. Date of appl., Jan. 22, 1914.

A CYLINDER, 19, is built up of a number of hollow longitudinal sections, 2. One wall, 3, of each section projects into the cylinder, 19, and as the whole is rotated, these projections serve to lift up and stir the material, which is passed through the cylinder in one direction, whilst hot gases from a furnace are passed through the hollow sections, 2, in the reverse direction.

—W. H. C.



Desiccating apparatus. E. E. Eldredge, Chevy Chase, D.C. U.S. Pat. 1,134,731, April 6, 1915. Date of appl., April 11, 1914.

ATOMISED fluid to be desiccated is injected into the innermost of a number of communicating horizontal concentric cylinders, and travels between the concentric walls, from which the dried residue is removed by conveyors.—W. F. F.

Liquids; Evaporation and distillation of.—C. T. Thorssell, Gothenburg, and H. L. R. Lundén, Stockholm, Sweden. Eng. Pat. 9295, April 14, 1914.

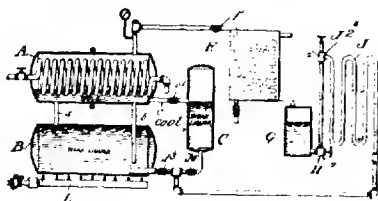
To avoid loss due to the latent heat of the vapour, distillation is effected at or near the critical temperature and pressure of the liquid. The vapour produced at the critical point is condensed at a slightly lower temperature and pressure in a coil immersed in the fresh liquid which is being pumped to the still. This liquid is thereby heated to nearly the critical point. The energy still contained in the condensed liquid is used to drive a reciprocating piston which operates the pump.—W. F. F.

Filtering; Cloths for.—T. D. Morson and C. S. Roy, Ponders End, Middlesex. Eng. Pat. 10,527, April 28, 1914.

A FILTER cloth which resists acids, alkalis, and alkaline hypochlorites, is woven from threads composed of glass wool or like vitreous silicious material.—W. F. F.

Refrigeration; Process of.—Refrigerating apparatus. W. J. Kelly, Chicago, Ill. Assignor to Autovacuum Refrigerating Co., New Orleans, La. U.S. Pats. 1,122,602 and 1,122,603, Dec. 29, 1914. Date of appl., March 5, 1914.

THE apparatus consists of two superposed vessels, A, B, connected by the pipes, a, b, provided with an auxiliary tank, C, and connected with a con-



denser, E, a reservoir for liquefied ammonia, G, and a refrigerating coil, J. Starting with A and B full of strong liquor, C partly full of weak liquor, and G partly full of condensed ammonia, which passes through the valves, H, J², to the coil, J, where it is expanded and produces the required

refrigeration, B is heated by the burner, L, or by a steam coil. The greater part of the ammonia and a portion of the water is distilled off and condensed, the condensed liquid collecting in G. During this time the expanded ammonia from the coil, J, is absorbed by the weak liquor in C. When the distillation is completed and the volume of liquor in the containers reduced to the level shown, the heating is stopped and the valve, F¹, is closed and D² and D³ are opened. The condensed ammonia is now absorbed by the weak liquor remaining in B, and the strong liquor from C also passes into B. When C is empty it cools and a vacuum is formed, so that some of the weak liquor resulting from the mixture of strong liquor from C with the weak liquor in B, returns and fills C to the level of the pipe, c. The valve, c¹, is now closed, and the reserve of weak liquor is held till the liquor in A, B, is saturated with ammonia; when this is the case the valve, D³, is closed and the valves, F¹ and D², are opened, and the ammonia is again distilled off from A, B, the weak liquor in C serving to absorb the ammonia while the distillation is taking place.—W. H. C.

Kiln; Downdraught, continuous.—F. D. Shaw, Chicago, Ill. U.S. Pat. 1,133,582, March 30, 1915. Date of appl., March 9, 1912.

HOT gases from oil burners are forced downwards into a central heating chamber formed above the arched roof of a tunnel kiln. The hot gases pass downwards from this chamber on to the materials travelling through the kiln, through passages formed along the arched roof.—W. H. C.

Kiln; Continuous compartment gas-fired.—W. D. Richardson, Worthington, Ohio. U.S. Pat. 1,133,885, March 30, 1915. Date of appl., June 9, 1913.

GAS passes from a main to a distributing chamber, and thence by flues to several ports within the firing compartment, the ports being arranged in staggered relation to one another. Air is conveyed to the firing compartment by suitable flues and delivered downwards to the gas.—W. H. C.

Filtering apparatus; Rotary.—L. Hertenbein, Levallois-Perret, France. Eng. Pat. 22,840, Nov. 20, 1914. Under Int. Conv., Nov. 26, 1913. SEE Fr. Pat. 465,323 of 1913; this J., 1914, 540.

Filter. C. Butters, Oakland, Cal. U.S. Pat. 1,136,863, April 20, 1915. Date of appl., June 18, 1913.

SEE Fr. Pat. 472,017 of 1914; this J., 1915, 410.

Drying apparatus. G. Binder, Rochester, N.Y. Assignor to American Laundry Machinery Co., Cincinnati, Ohio. U.S. Pat. 1,136,645, April 20, 1915. Date of appl., Jan. 21, 1914.

SEE Eng. Pat. 8836 of 1914; this J., 1915, 16.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal and coke; Exportation of.—Board of Trade J., May 13, 1915.

By an Order in Council dated May 6th, the exportation of coal (including anthracite and steam, gas, household, and all other kinds of coal) and coke is prohibited on and after May 13th to all destinations abroad other than British Possessions and Protectorates and Allied Countries.

Coal dust; Influence of the quantity and method of distribution of — on its explosiveness and on the strength of the explosion. K. J. Czaplinsky. Oesterr. Zeits. Berg- u. Hüttenw., 1914, 62, 501-509. Z. angew. Chem., 1915, 28, Ref., 51.

This is the fifth report on the tests made in the experimental gallery at Babitz in the Rossitz-Osluau coal district (see this J., 1909, 1224; 1910, 1083; 1912, 629). To lessen the influence of the compression wave preceding the explosion wave on the density of the dust cloud, the dust zones were made as long as possible (up to 294 m.). For the dust examined, the limits within which explosion occurred were 40 grms. and 2000 grms. respectively per cb. m. of air. With increasing density of the dust cloud the force of the explosion increased to a maximum and then decreased. The flame velocities observed were as follows:—40 grms. of coal dust per cb. m. of air, 34 m. per sec.; 60 grms., 60 m.; 80 grms., 65 m.; 100 grms., 90 m.; 200 grms., 170 m.; 800 grms., 108 m.; 1600 grms., 55 m.; and 2000 grms. of coal dust per cb. m., 14 m. per second. Further experiments are to be made in a gallery 600 m. long, as trustworthy results can be obtained only when very long dust zones are used.—A. S.

Coke breeze briquettes. Behr. J. Gasbeleucht., March 6, 1915. J. Gas Lighting, 1915, 130, 212-213.

The utilisation of coke breeze in gas works for firing boilers necessitates the use of special grates, blowers, etc., and is generally unsatisfactory. In specially constructed suction producers it gives good results, but the demand for breeze for these plants is relatively small; moreover, the demand for breeze for paving and building purposes has fallen, the cheaper clinker being used largely in its stead. At the Kolberg Gas Works good results have been obtained in the manufacture of coke-breeze briquettes by mixing the fine breeze with about 6% of finely divided hard pitch, tipping the mixture into the receiver of an elevator, and transferring it to a funnel-shaped mixing machine into which superheated steam and waste furnace gases are led. This is sufficient to melt the hard pitch, and the hot mixture passes through an outlet at the bottom of the mixer into a filling vessel placed above a rotating moulding table. The briquettes are about 2½ in. long by 2½ in. diam., and when hot are strong enough to withstand handling with coke forks. They may be used in all cases where the layer of fuel is not less than 8-10 inches, and where the draught is sufficient for ordinary 2-inch coke. The best results are obtained in closed iron stoves, central heating plant, etc. The cost of manufacture is 5½d. per cwt., the lowest selling price on the works is 8½d. per cwt., and under the least favourable circumstances the profit is 4s. 7d. per ton. A complete installation costs £225; with one press working for 300 days of 10 hours in the year. 1050-1125 metric tons of coke briquettes was produced.

—E. R. A.

Calorimetric bomb; Manipulation of the —. Calculation of heats of combustion. W. A. Roth. Annalen, 1915, 407, 112-133. J. Chem. Soc., 1915, 108, ii., 145-146. (Compare this J., 1910, 783).

The following subjects are discussed: (1) The correction for the exchange of heat with the surroundings. (2) The determination of the water-equivalent of the apparatus. It is shown that the mere exchange of one thermometer for another affects the value. (3) The use of benzoic acid and of sucrose for calibration purposes. (4) The calibration of the apparatus by an electrical method. The difference between this and the thermal method is only about 0.1%. (5) Factors to be used in comparing the thermochemical data of

different investigators. (6) In many cases the molecular heat of combustion of a liquid or solid substance can be roughly calculated by multiplying by 52.2 the number of atoms of oxygen required for the complete combustion of one molecule of the substance.

Calorimetric bomb; Combustion of volatile substances in the —. W. A. Roth and H. Wallasch. Annalen, 1915, 407, 134-145. J. Chem. Soc., 1915, 108, ii., 146.

The combustion of the vapour of a volatile substance is incomplete, even in the presence of a large excess of oxygen. The authors have tested the methods of overcoming this difficulty proposed by various investigators, and come to the conclusion that no method is applicable universally. In the "protective" methods the use of combustible envelopes is not recommended; glass envelopes are preferable. The following devices, arranged in order of increasing efficiency, are recommended: glass vessels with small caps of gelatin, or, better, celluloid; enclosure of the platinum combustion dish by a glass cover sealed with vaseline, or, best of all, by a "cellon" or "cellophan" cover sealed with vaseline.

Benzol from coal gas; Recovery of —. W. Diamond. North of Eng. Gas Managers' Assoc., May 1, 1915. J. Gas Lighting, 1915, 130, 267-270.

To recover the maximum quantity of benzol from coal gas, the washing oil should have a sp. gr. between 1.04 and 1.06; when it reaches the latter figure it should be rejected. Comparative experiments with different washing oils showed that coal-tar creosote absorbed five times as much benzol as filtered anthracene oil. The amount of water in the washing oil should not exceed 1%; the presence of 2.5% in creosote reduces its efficiency by over 35%, 7.5% by 45%, and 10% by 73%. By reducing the temperature of the gas below 15°C. and that of the washing oil to 0°C., absorption is increased by 20% but the cost of the cooling is prohibitive. The extraction of 2.1 gallons of benzol from gas per ton of coal results in a decrease of 4.5% in the calorific value of the gas; removal of 2.5 galls. shows a decrease of 7% and of 3 galls. a decrease of 8%.

Mineral oil production of the Red Sea Fields. Board of Trade J., May 6, 1915.

The development of the Red Sea oilfields progressed very satisfactorily during 1914. The total production of oil from the fields during the year considerably exceeded the output for the previous year; moreover it is anticipated, in view of the fact that oil is now being obtained from the concessions south of Gemsa, that a far larger output will be obtained during 1915. The crude oil is transferred from Gemsa or Hurghada to the refinery at Suez, where it is converted into benzene, kerosene, and liquid fuel. In 1914 the quantity of crude oil imported into Suez for refining was 119,349 metric tons, valued at £E. 179,025, and of heavy benzene distillate 11,893 metric tons, valued at £E. 83,251. The output of the refined products was as follows:

	Used in Egypt.		Exported to the East, France, and the Mediterranean.	
	Metric tons.	£ E.	Metric tons.	£ E.
Liquid fuel	6,923	17,307	47,248	118,129
Kerosene	8,638	43,190	22,154	110,770
Refined benzene	1,188	11,860	8,227	82,270
Unrefined benzene	2	14	16,921	16,921
Total	16,740	72,371	94,550	328,089

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Ethane and ethylene; Separation of —, by fractional distillation in a vacuum at low temperatures. G. A. Burrell and I. W. Robertson. J. Amer. Chem. Soc., 1915, 37, 896–902.

ALTHOUGH ethane (b. pt. $-93^{\circ}\text{C}.$) and ethylene (b. pt. $-103^{\circ}\text{C}.$) may be completely separated by fractional distillation at low temperatures (see this J., 1915, 411), the operation is tedious when a considerable proportion of each gas is present in the mixture.—J. R.

Dehydration of water-gas tar at the Amsterdam Western Gas Works. See III.

Progressive reduction of acetylene. Paal and Hohenegger. See XX.

Determination of carbon monoxide by the iodine pentoxide method. Froboese. See XXIII.

PATENTS.

Coal briquettes; Method of carbonising water-soluble binding materials in —. Diamant-Brikettwerke G. m. b. H. Ger. Pat. 280,454, July 8, 1913.

THE briquettes are exposed at once to a temperature of 190° – $200^{\circ}\text{C}.$, so that most of the water evaporates before an impermeable skin is formed on the surface, and carbonisation is then effected in the usual way.—A. S.

Coal briquettes with sulphite-cellulose waste lye as binding material; Manufacture of —. B. Grätz. Ger. Pat. 280,455, Nov. 21, 1913.

FINE coal is mixed with powdered blast-furnace slag, plaster of Paris, cement, or like material capable of combining with water and holding it in combination at temperatures up to $110^{\circ}\text{C}.$; the mass is mixed with about 14% of sulphite-cellulose waste lye containing 50% H_2O , heated, and formed into briquettes, which are heated to carbonise the sulphite-lye.—A. S.

Forestry waste as fuel; Utilisation of —. F. von Kalitsch. Ger. Pat. 280,869, June 14, 1914. Under Int. Conv., Oct. 20, 1913.

LEAF-BEARING material and roots of woody plants are finely divided, mixed with ground wood charcoal or the like, and briquetted.—A. S.

Coke oven for heating with either rich gas or low-grade gas. C. Still. Ger. Pat. 281,252, Aug. 21, 1913.

REGENERATORS for preheating the air for combustion are arranged alternately with recuperators for preheating the heating gas, on both sides of the oven and along the full length of the battery of ovens; the waste gases pass through the regenerators on one side of the oven whilst air is passing through those on the other side. The heating gas may be passed through the recuperators on the same side of the oven as the regenerators through which air is passing, or through those on the opposite side.—A. S.

Gas; Manufacture of — in vertical retorts. J. Bueb. Ger. Pat. 280,746, Sept. 4, 1913.

IN the event of excessive pressure developing in the retorts, steam is blown in at the lower part, whereupon normal conditions are soon restored.—A. S.

Gas generators. G. H. Bentley and E. G. Appleby, London. Eng. Pat. 9040, April 9, 1914.

TO avoid caking of the fuel and clinker formation, the casing is lifted and lowered relatively to the grate and simultaneously revolved eccentrically to the grate.—W. F. F.

Gaseous fuels; Calorimetry of —. H. F. Smith, Lexington, Ohio. U.S. Pat. 1,134,768, April 6, 1915. Date of appl., Feb. 5, 1910.

THE fuel and air in predetermined proportions and at a pressure and temperature which may vary, but must be the same for both, are supplied to a combustion chamber which is at atmospheric pressure. The rise of temperature of the air and combustion products is measured.—W. F. F.

Lubricating oils and greases; Treatment of —. H. E. Wilkinson and H. Steward, London. Eng. Pats. 8279, Apr. 1, and 15,040, June 23, 1914.

WASTE oil or grease, after passing through a filter and magnetic separating apparatus, is heated, mixed with 25% of flour, and cooled in a closed vessel to obtain a lubricant for use in gear-boxes and the like.—W. F. F.

Drying oils; Manufacture of — from products of distillation of mineral oils. De Bataafsche Petroleum Maatschappij, The Hague. Eng. Pat. 23,376, Dec. 1, 1914. Under Int. Conv., Dec. 31, 1913.

A SUBSTITUTE for linseed and similar drying oils is obtained by chlorinating mineral oils and converting the chloro-derivatives into unsaturated compounds by the elimination of hydrochloric acid by heating in presence of a catalyst, such as a metal, preferably zinc, or a metallic chloride.—F. W. A.

Mineral oils and other fluid mixtures of hydrocarbons of analogous composition; Process for improving the quality of —. Badische Anilin und Soda Fabrik. Fr. Pat. 472,776, May 28, 1914. Under Int. Conv., Sept. 1, 1913.

THE oils, etc., are decolorised and deodorised by treatment in the fluid condition with hydrogen, at not above $200^{\circ}\text{C}.$, at atmospheric or increased pressure, and in the presence of a catalyst, such as nickel, iron, cobalt, or copper, or mixtures of these.—C. A. M.

Oven for generating gas and producing coke. H. Koppers, Essen, Germany, Assignor to H. Koppers Co., Chicago, Ill. U.S. Pat. 1,134,683, April 6, 1915. Date of appl., Oct. 21, 1914.

SEE Fr. Pat. 460,517 of 1913; this J., 1914, 68.

Manufacture of lime and gas. Eng. Pat. 5734. See VII.

Process of desulphurising oils, resins, and rubber. Fr. Pat. 473,110. See XII.

Process of rendering petroleum soluble, and product resulting therefrom. Fr. Pat. 472,873. See XIXa.

Analysis of gas mixtures. Ger. Pat. 281,584. See XXIII.

Quantitative gas analysis by an acoustic method. Ger. Pat. 281,157. See XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Coal distillation; Products of —. W. J. A. Butterfield. An address delivered at the Cardiff Conference on the extension of British trade, April 20. J. Gas Lighting, 1915, 130, 205–209.

THE output of coal in the United Kingdom in 1913 was 287,430,473 tons, whilst that of Germany was 274,578,000 tons, including 86,093,000 tons of brown coal. The export of coal from Great Britain is, however, much greater than that from

Germany. The quantities retained for home consumption in 1913 were 189,092,369 and 248,958,000 tons respectively, of which 37,483,944 and 62,613,000 tons were carbonised. In Great Britain 42.7% of the total coal carbonised was carbonised in gas works; in Germany 14.4%. As Germany carbonises more coal, and in so doing utilises coke ovens to a greater extent, the raw materials required for many chemical industries are produced in larger quantities than in Great Britain. This advantage is primarily due to the development of the iron industry, which consumes enormous quantities of oven coke, and the possibility of making the home supplies of tar and benzol in the United Kingdom equal to those of Germany, depends very much on our obtaining a supply of good grade iron ore at a price which will enable us to produce pig-iron and steel as cheaply as in the United States, Belgium, and Germany.

Products from the distillation of 100 tons of bituminous coal. The gross yield of coke obtained by the distillation of an average coal is about 70%, of which about 47.5% is saleable, the difference being due to the consumption of coke as the sole fuel for heating the retorts, and also to the production of small breeze which has practically no value, although means of briquetting it have been devised in Germany (see page 539). The yield of saleable coke from coke ovens is about 60%. Retort carbon has a fairly high market value, but the amount obtained is often less than 0.10%. The volatile products of the distillation include about 6 cwt. of ammonia which yields 24 cwt. of high-grade ammonium sulphate, i.e., containing 25% NH₃. Cyanogen compounds are present to the extent of 50–200 grains of cyanogen per 1000 cub. ft. and are partially abstracted in the cooling and washing and partially in the oxide of iron purifiers. Special processes are applied at large works, especially in Germany, for the direct extraction of cyanogen compounds from the crude gas. Gas from coke ovens usually contains much less cyanogen than that from gas retorts. It is probable that German gas works alone have yielded in recent years cyanogen products equivalent to 10,000 tons of yellow prussiate per annum, while the output from the United Kingdom has not exceeded 5000 tons per annum, a quantity which could be increased to 24,000 tons, if cyanogen extraction were extended to all the gas works. The average yield of cyanides from coal gas in this country should be about 2 cwt. of Prussian blue or 3 cwt. of yellow prussiate or 2 cwt. of sodium cyanide per 100 tons of coal carbonised. By careful working, cyanogen recovery might be extended profitably in this country, and a large proportion of the German export trade in cyanides captured. Hydrogen sulphide and carbon bisulphide are the chief sulphur compounds, and are present to the extent of approximately half a ton of the former and 72 lb. of the latter per 100 tons of coal carbonised. The hydrogen sulphide is generally retained by the oxide of iron in the purifiers, and is finally utilised in the manufacture of sulphuric acid. The amount of acid produced corresponds to 1.8 tons of sp. gr. 1.71. This is more than sufficient to neutralise the ammonia present in the volatile products, and the problem of how to oxidise the sulphur compounds and combine it with ammonia in a single operation, is one worthy of immediate attention. Carbon bisulphide can be effectively removed at small cost where gas of a high degree of purity is required. In practice from 1.5 to 3.0 gallons of benzol are obtained from 1 ton of coal, the average being about 2.25 gallons per 100 tons of coal carbonised, and it has been ascertained that one-third of the benzol present in coal gas may be abstracted without impoverishing the gas unduly. If this were done it is estimated that the gas works of the United Kingdom could produce 12,000,000 gallons

of benzol per annum, and the coke-ovens another 60,000,000 gallons. The yield of coal tar, freed from water, may be taken as 1000 gallons per 100 tons of coal.—E. R. A.

Separation and identification of certain homologous α -diketones [diacetyl, etc.]. Johlin. *See* XX.

PATENTS.

Arc light carbons. H. Ayrton, London. Eng. Pat. 8505, April 3, 1914. Addition to Eng. Pat. 22,319 of 1913 (this J., 1914, 686).

THE negative carbon, covered with copper, is cored, a carbon pencil is inserted in the hole, and the intermediate space is filled with a packing of material which will be consumed during use, leaving a hollow near the tip of the inner pencil. —B. N.

Electrode; Arc-light —. W. R. Mott, Lakewood, Ohio, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,134,148, April 6, 1915. Date of appl. June 6, 1913.

THE electrode contains a carbonate, a calcium salt, precipitated silica, and an oxide of tungsten mixed with carbon.—B. N.

Carbon filaments for electric incandescence lamps; Manufacture of —. Siemens u. Halske A.-G. Ger. Pat. 281,015, Feb. 12, 1914.

A SOLUTION of bakelite is used as binding material for the carbon. Bakelite yields a very strong, uniform carbon, and even small quantities have a high binding power. The filaments produced are of uniform structure and low porosity.—A. S.

III.—TAR AND TAR PRODUCTS.

Water-gas tar; Dehydration of — at the Amsterdam Western Gas Works. J. Gas Lighting, 1915, 130, 196.

A CENTRIFUGAL plant which reduced the water in coal gas tar from 25–30% to 2–3% in one operation, was tried with water-gas tar. The first experiments were unsuccessful, but by working at higher temperatures very satisfactory results were obtained. The difference in specific gravity between water-gas tar and water increases considerably with rise of temperature. The centrifugal machine used has a drum revolving at a high rate of speed on a vertical shaft; at the upper part of the interior of the drum is fixed a flat ring, 4 inches wide, fitted so that a small space is left between the inner surface of the drum and the outer circumference of the ring. The tar travels upwards along the inner surface of the drum to the upper surface of the ring, and thence to the tar off-take. The water, being lighter, forms a layer at the side of the tar, and travelling upwards its passage is barred by the ring, so that it is forced along the underside of the ring where the water outlet is fixed. The temperature necessary for the perfect dehydration of the tar is between 60° and 70° C., which is obtained by preheating the tar in a rectangular tank fitted with an outlet pipe for the escape of any gaseous products. The heated tar has often a water content of about 60%, and this is reduced to less than 1% in one operation. Water-gas tar emulsions containing 80–90% of water have been treated in the same apparatus, the working temperature being 95°–100° C., no trouble due to evaporation being experienced at this temperature. The tar obtained has a very low content of "free carbon," viz., 0.4%, and the average calorific value is 17,200 B.Th.U. per lb. The working costs of the treatment are particularly low, and owing to its uniform character

the tar is used largely as a substitute for mineral oil fuel, and commands better prices than those obtained for tar not centrifugally treated.—E.R.A.

Acetylene condensations; Pyrogenic — R. Meyer and H. Fricke. Ber., 1914, 47, 2765—2774. Z. angew. Chem., 1915, 28, Ref., 58.

THE presence of *m*- and *p*-xylene, *o*- and *β*-methylnaphthalene, 1,4-dimethylnaphthalene, and hydro-derivatives of naphthalene has been detected in the tar obtained from acetylene (this J., 1912, 633; 1913, 1060). Twenty-three compounds present in ordinary coal tar have now been detected in the acetylene-tar. Aqueous liquor withdrawn from the first furnace of the apparatus contained phenol, acetic acid, and formic acid, produced probably as a result of oxidation by air leaking into the apparatus.—A. S.

Ebullioscopic behaviour of solvents at different pressures. III. Aniline, phenol, naphthalene, and diphenyl. E. Beckmann and O. Liesche. Z. physik. Chem., 1914, 89, 111—124. J. Chem. Soc., 1915, 108, ii., 144.

THE ebullioscopic constants of aniline and phenol have been determined at thirteen different pressures from 760 mm. to 150 mm. naphthalene at four pressures from 763 mm. to 172 mm., and diphenyl at the three pressures, 754, 458, and 188 mm. It is shown that aniline and phenol are very similar in their ebullioscopic behaviour. The constants are very close together even at reduced pressures. The experimental values of the constants agree well with the calculated constants, except those obtained from the Walden formula, and in this case the divergence is greater in the case of phenol than in that of aniline. This indicates a greater association in the case of phenol, and also that aniline is not a strictly normal liquid, even though the association is only slight. The constants obtained experimentally for naphthalene and diphenyl agree satisfactorily with the theory. It is therefore shown that the calculation of the ebullioscopic constants from critical data is allowable in the case of high-boiling liquids. The newly-determined values of *K* are: aniline, 36.9; phenol, 36.0; naphthalene, 58.0; and diphenyl, 70.6.

Chloranil and bromanil; Preparation of — from phenol. Chlorination by means of aqua regia. R. Kempf and H. Moehrke. Ber., 1914, 47, 2615—2622. Bull. Soc. Chim., 1915, 18, 148.

THE best yields of chloranil were obtained by dissolving 10 grms. of phenol in 225 c.c. of concentrated hydrochloric acid and saturating the solution with chlorine, cooling first with water, and afterwards warming on a water-bath. After adding 75 c.c. of concentrated nitric acid, the heating was continued for about 20 hours. Yield 8.9 grms., m. pt. 285°—286° C. Under other conditions oxalic acid and 2,4-dinitro-6-chlorophenol were also produced to the detriment of the chloranil. Bromanil was obtained by adding 25 c.c. of concentrated nitric acid to a solution of 3 grms. of phenol in 74 c.c. of hydrobromic acid (sp. gr. 1.38), and heating for a long time after the initial spontaneous reaction had subsided. The yield was 4.3 grms. of an orange coloured product, m. pt. 260°—270° C. Bromanil was also produced by the action of bromine and nitric acid on phenol. Iodine and nitric acid convert phenol into 2,4-dinitro-6-iodophenol, m. pt. 106°—107° C.—G. F. M.

Nitrosobenzene; Action of acetic anhydride on —. A. Kluge and H. Huber. Tibinger Chem. Ges., Feb. 26, 1915. Chem.-Zeit., 1915, 39, 229.

ON boiling nitrosobenzene with acetic anhydride,

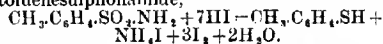
a mixture of azoxybenzene and nitrobenzene together with a little acetanilide and an unidentified substance of m. pt. 245° C. was obtained.—A. B. S.

Benzene derivatives; Replacement of substituents in —. A. F. Holleman. Proc. K. Akad. Wetensch. Amsterdam, 1915, 17, 1027—1034. J. Chem. Soc., 1915, 108, i., 129.

THREE points have been tested, viz., (1) the velocity of transformation in a complete set of isomerides, (2) the effect of changing the reacting agent, and (3) the effect of temperature. The influence of position, of the reagent, and of temperature on the velocity constant followed no definite rule. The three dichlorobenzenes, three chloronitrobenzenes, and six dichloronitrobenzenes have been studied, with regard to the replacement of chlorine by sodium methoxide and diethylamine. It has been found that the replacement of chlorine is largely dependent on the position of the substituents, and influenced by the reagent employed, and that, although the temperature coefficient is fairly constant for one set of isomerides and one reagent, it is not the same for the two reagents, the reaction with sodium methoxide being influenced much more than the reaction with diethylamine.

Arylsulphonamides; Reduction of — by hydriodic acid. E. Fischer. Ber., 1915, 48, 93—102. J. Chem. Soc., 1915, 108, i., 138—139.

THE value of the arylsulphonyl derivatives of organic bases and amino-acids for the isolation of this class of compound is seriously diminished by the difficulty of regenerating the original amino-compound. It is now found that hydriodic acid (with the addition of phosphonium iodide) is a convenient reagent for effecting the recovery of the parent substance, because in a closed vessel at 70°—100° C., concurrent reduction and fission occur which may be typified by the result with *p*-toluenesulphonamide,



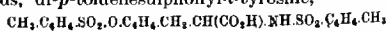
In a like manner the corresponding *p*-toluenesulphonanilide and *p*-toluenesulphonylglycine undergo fission, regenerating the amino-compound. The method is especially useful for the recovery of the optically active amino-acids from their arylsulphonyl derivatives. *p*-Toluenesulphonyl-diphenylalanine,



yields *d*-phenylalanine in excellent yield and approximate optical purity, and by making use of this process *l*-tyrosine has been converted through the *p*-toluenesulphonyl compound and its methyl derivative into active *N*-methyltyrosine, which was identical with natural thauanin.

Toluenesulphonyl chloride is also sensitive to hydriodic acid, but the free acid and its ethyl ester resist the action of hydriodic acid under similar conditions; saccharin is also resistant.

There is a marked difference between the behaviour of the arylsulphonyl radicle attached to an oxygen atom, and that attached to nitrogen; thus, di-*p*-toluenesulphonyl-*l*-tyrosine,



on treatment with hydriodic acid and phosphonium iodide at 100° C. gives *p*-tolylmercaptan, m.pt. 43°—44°, and *O*-*p*-toluenesulphonyl-*l*-tyrosine, m.pt. 218° C. (corr. decomp.) $[\alpha]_D^{20} = -4.58^\circ$ in *N*/*l* sodium hydroxide solution. The striking difference between the behaviour of the free sulphonic acid and its amides extends also to the corresponding benzyl compounds. Benzylsulphonic acid is not reduced, whereas its amide enters into reaction, readily giving, however, benzyl iodide and hydrogen sulphide in addition to ammonia.

Benzotetronic acid [4-hydroxycoumarin]; Formation of monophenolic ketones and a new synthesis of —. H. Pauly and K. Lockemann. Ber., 1915, 48, 28—32. J. Chem. Soc., 1915, 108, i., 146.

CONTRARY to the observation of Nencki (this J., 1890, 411), phenol readily undergoes condensation with acetic acid in the presence of zinc chloride, the expected *o*- and *p*-hydroxyacetophenones being separable without difficulty, in respective yields of approximately 5 and 11% of the theoretical. The authors do not regard the acetylation of the hydroxyl group as a necessary intermediate stage in the action. It is found that the additional presence of acetic anhydride has a less favourable effect in the acetylation of phenol than of naphthol, whereas an addition of acetyl chloride causes a marked increase in the yield of the *p*-acetyl derivative. The development of a yellow coloration during acetylation with or without the presence of acetyl chloride is regarded as indicative of the formation of an intermediate compound of organometallic type such as is assumed in the Friedel-Crafts reaction.

4-Hydroxycoumarin (benzotetronic acid) can be obtained in a yield 55% of the theoretical, by treating methyl *o*-acetoxybenzoate with sodium at 165°—175° C. This condensation appears to be a general one for esters of *o*-acyloxybenzoic acids, and methyl *o*-phenylacetoxybenzoate, obtained by heating together methyl salicylate, phenylacetic acid, acetic anhydride, and a little sulphuric acid, likewise undergoes condensation on treatment with sodium at 160°—165° C., giving phenylbenzotetronic acid (4-hydroxy-3-phenylcoumarin), m.p. 236° C.

Anthradiquinone-1.4.9.10. R. Lesser. Ber., 1914, 47, 2526—2528. Bull. Soc. Chim., 1915, 18, 159.

1.4.9.10-ANTHRADIQUINONE was prepared by oxidising quinizarin dissolved in boiling benzene with a large excess of lead peroxide. It forms long reddish-brown needles, which commence to sublime at about 160° C., and melt towards 185° C. It dissolves in organic solvents giving reddish-yellow to brown solutions which exhibit marked fluorescence. It is also soluble in sulphuric and nitric acids, is stable in the air, and possesses the properties characteristic of quinones.—G. F. M.

Recovery of benzol from coal gas. Diamond. See IIa.

PATENTS.

Chloro-compounds; Preparation of aromatic —. Kinzberger und Co. Ger. Pat. 280,739, Aug. 3, 1913.

AROMATIC nitro-compounds are treated with thionyl chloride above 160° C. The nitro groups and also sulpho groups and hydrogen atoms of aliphatic side chains are replaced by chlorine. The chlorination of nitrobenzene, dinitroanthraquinone, and *p*-nitrotoluene is described.—A. S.

Phenols and their monochloro substitution products; Preparation of monohydric —. Chem. Werke Ichenroff G. m. b. H. Ger. Pat. 281,175, July 10, 1913.

MONO- or dichloro substitution products of aromatic hydrocarbons are heated for a long time with an alkali hydroxide and methyl alcohol, with or without addition of other solvents. The method can be used for the preparation of phenol from chlorobenzene, *o*- or *p*-chlorophenol from *o*- or *p*-dichlorobenzene, and α -naphthol from α -chloronaphthalene. In many cases the yields are nearly quantitative. It is not necessary to use anhydrous methyl alcohol.—A. S.

Condensation products of the anthraquinone series; Preparation of ether-like —. Farb. vorm. Meister, Lucius, u. Brünig. Ger. Pat. 280,975, March 14, 1913.

ALIZARIN or one of its substitution products is condensed with an ethylene halide in presence of a substance capable of combining with hydrohalogen acids, and with or without addition of a catalyst, such as copper or a copper compound. The products are useful for the preparation of dyestuffs. The compound obtained from a dialkali salt of alizarin and ethylene bromide forms an orange vat with alkaline hydrosulphite solution.—A. S.

Anthraquinonemercaptans; Preparation of —. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 281,102, Aug. 1, 1913. Addition to Ger. Pat. 201,772.

ANTHRAQUINONEMERCAPTANS are obtained by heating anthraquinonesulphochlorides with alkali sulphides or polysulphides. Sulphinic acids are formed if the reaction mixture be not heated.—A. S.

Istidins; Preparation of —. Farb. vorm. Meister, Lucius, und Brünig. Ger. Pat. 281,052, July 19, 1913.

CONDENSATION products of *o*-nitro-aldehydes capable of yielding indigo on treatment with alkalis, e.g., 3,6-dichloro-2-nitrophenyl-lactic methyl ketone, 3,6-dichloro-2-nitrophenyl-lactic aldehyde, or 5-methyl-2-nitrophenyl-lactic methyl ketone, are treated with alkaline oxidising agents, e.g., permanganates, hypochlorites, or ferricyanides, in aqueous solution, whereby they are converted into the corresponding istidins.—A. S.

Aryldiazo compounds containing boron and fluorine; Preparation of complex —. H. Bart. Ger. Pat. 281,055, Oct. 7, 1913.

COMPLEX aryldiazo compounds containing boron and fluorine, more stable than other solid diazo salts, are obtained by the interaction of aromatic diazo compounds with complex borofluoric acids or their salts.—A. S.

Aromatic amines; Preparation of —. C. von Girsawald. Ger. Pat. 281,100, Feb. 6, 1914.

AROMATIC nitro compounds are reduced by hydrogen or a mixture of hydrogen with other gases, e.g., with carbon dioxide or with gases containing carbon dioxide, in presence of water and a catalyst, under high pressure and at a temperature above the boiling point of the amine produced. Iron turnings may be used as catalyst. The process may be made continuous by providing a loaded valve for the escape of the amine vapour.—A. S.

o-Aminobenzenesulphonic acid; Preparation of —. J. Obermiller. Ger. Pat. 281,176, Oct. 5, 1913.

THE reaction mixture obtained by sulphonating benzene, containing as little free sulphuric acid as possible, is nitrated at a temperature above atmospheric, and the mixture of nitro-compounds is reduced. The isomeric aminobenzenesulphonic acids are separated by fractional crystallisation of their magnesium salts; or the nitrobenzenesulphonic acids may be separated in like manner, before reduction; in both cases the salt of the *o*-acid is the most soluble. (See also this J., 1914, 130.)—A. S.

Aldehydes; Preparation of aromatic —. C. F. Boehringer und Söhne. Ger. Pat. 281,212, Aug. 7, 1913.

AROMATIC aldehydes are obtained by the action of carbon monoxide under pressure, e.g., 40—90 atmospheres, on aromatic hydrocarbons or their substitution products in presence of aluminium

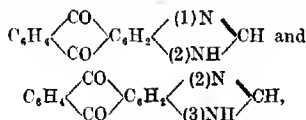
chloride. Good results are obtained even in those cases where Gattermann's process (this J., 1897, 832; also Eng. Pat. 13,709 of 1897; this J., 1898, 572) either fails or gives poor yields.—A. S.

Unexplosive preparation [nitro-compounds]. Non-explosive preparations and process of making same. A. Schmidt, Assignor to Farb. vorm. Meister, Lucius, und Brünig, Hoechst, Germany. U.S. Pats. 1,136,723 and 1,136,724, April 20, 1915. Dates of appl., Sept. 29, 1913 and Sept. 22, 1914. SEE Fr. Pat. 463,288 of 1913; this J., 1914, 413.

IV.—COLOURING MATTERS AND DYES.

Iminazoles of the anthraquinone series. A. Schaarschmidt. Annalen, 1915, 407, 176—194. J. Chem. Soc., 1915, 108, i, 177—178.

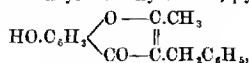
THE 1.2- or 2.3-diaminoanthraquinones condense quantitatively with anthraquinone-2-carboxylic acid or -2-aldehyde or *o*-dichloro-2-methylanthraquinone, and incompletely with anthraquinone-1-carboxylic acid or its nitrile, in presence of sulphuric or acetic acid. The iminazoles of the types:



produced from the highly coloured *o*-diaminoanthraquinone, are faintly yellow and do not yield vat dyestuffs; but the 2-phenyl derivatives are yellow and dye cotton from the vat. Anthraquinone-iminazoles containing an anthraquinonyl group also give vat dyestuffs, unless this group has been produced from anthraquinone-1-carboxylic acid or its nitrile. The acid character of the anthraquinone-iminazoles increases rapidly with the molecular weight. Those of the above types, but not the 2-phenyl derivatives, dissolve in dilute mineral acids. Sodium hypochlorite and bromine water have no action on anthraquinone-iminazoles, and alkaline reducing agents only attack the carbonyl groups.—F. W. A.

Benzo- γ -pyrones and flavones; Syntheses of— I. S. Jacobson and B. Ghosh. Chem. Soc. Trans., 1915, 107, 424—434.

THE condensation of unsubstituted or methyl-substituted aceto- or benzoyl-acetic esters with phenols in presence of sulphuric acid, leads to the formation of substituted coumarins, but if the ester contains a group of greater complexity, benzo- γ -pyrones are produced. Thus ethyl benzylacetoacetate condensed with resorcinol to give 7-hydroxy-3-benzyl-2-methylbenzo- γ -pyrone,

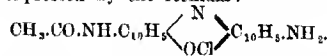


which formed long yellowish needles, m. pt. 186° C. In a similar manner γ -pyrones were prepared from ethyl benzylacetoacetate and *m*-cresol, α -naphthol, pyrogallol, phloroglucinol, and orcinol. They formed yellow or white needles, and exhibited a greenish fluorescence in concentrated sulphuric acid.—G. F. M.

Azoic colouring matters; Synthesis in the group of— F. Kehrman and D. Kissine. Ber., 1914, 47, 3096—3100. Bull. Soc. Chim., 1915, 18, 168—169.

4-ACETAMINONAPHTHOL, m. pt. 178° C., was converted through its nitroso-derivative by reduction with sodium sulphide into 4-acetamino-2-amino-naphthol. The hydrochloride of this amine was

oxidised by ferric chloride to the corresponding *o*-naphthoquinone. When heated for an hour with aminonaphthoquinone in solution in methylalcohol, a reddish violet solution was formed which deposited violet blue needles of the chloride of a new colouring matter. The base itself is orange yellow, and it dissolves in alcohol and benzene with a yellowish fluorescence. In concentrated sulphuric acid it dissolves to a greenish black solution. The acetyl group can be removed by dilute sulphuric acid with the formation of the violet sulphate of the diamine. The properties of the colouring matter are similar to those of 3-aminonaphthophenazoxonium, and it is probable that it contains an amino-group in the *para* position to the azinic nitrogen and has a constitution expressed by the formula:



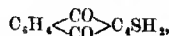
—G. F. M.

2-Amino-3-hydroxyphenazine; Synthesis of— F. Kehrman and D. Kissine. Ber., 1914, 47, 3100—3101. Bull. Soc. Chim., 1915, 18, 172.

AMINOHYDROXY-*o*-QUINONE condensed with *o*-phenylenediamine gives 2-amino-3-hydroxyphenazine, identical with the product obtained by the oxidation of *o*-phenylenediamine, the constitution of which is now therefore settled. *o*-Toluylenediamine similarly reacts with aminohydroxy-*o*-quinone, giving a mixture of two isomeric 2-amino-3-hydroxytoluphenazines.—G. F. M.

Thiophen; Condensation of— with phthalic anhydride. W. Steinkopf and W. Butkiewicz. Annalen, 1914, 407, 94—108. J. Chem. Soc., 1915, 108, i, 155.

o-2-THIENYLBENZOIC acid, $\text{CO}_2\text{H.C}_6\text{H}_4\text{.CO.C}_6\text{H}_4\text{SH}$, colourless crystals, m. pt. 145°, is prepared from thiophen, phthalic anhydride, and aluminium chloride in carbon bisulphide in the usual manner. Its constitution is proved by the formation of the compound by the oxidation of *o*-tolyl-2-thienyl ketone by chromic and acetic acids. Thiophanthraquinone,



yellow needles, m. pt. 227°—228° C., prepared by heating *o*-thienylbenzoic acid with phosphoric oxide at 150°, or with concentrated sulphuric acid at 105° C., sublimes readily, forms a brownish-yellow vat with alkaline hydrosulphite, and yields a nitro-derivative, $\text{C}_{11}\text{H}_7\text{O}_4\text{NS}$, yellow crystals, m. pt. 240°—241° C., by treatment with nitric acid of sp. gr. 1.5.

Isocurcumin. G. Heller. Ber., 1914, 47, 2998—3000. Z. angew. Chem., 1915, 28, Ref., 64. (See also this J., 1914, 544.)

CURCUMIN gives a bright reddish brown coloration with ferric chloride, whereas isocurcumin gives only a faint yellowish brown coloration. It is probable that the two compounds represent a case of keto-enol isomerism, isocurcumin being a mixture of stereoisomeric ketones with a small proportion of the enol form, whilst curcumin consists of the enol form. A substance with properties closely resembling those of isocurcumin, is obtained by heating curcumin with sodium carbonate solution. Curcumin is converted into hydrocurcumin by treatment with hydrogen in presence of platinum black, but isocurcumin cannot be hydrogenated in this way.—A. S.

Aromatic arsenic compounds. VIII. Some products of the reduction of 2,4-dinitrophenylarsinic acid, and a large class of new derivatives of carbaminic acid. Karzer. See XX.

PATENTS.

Dyestuffs of the anthraquinone series; Manufacture of greenish-blue — soluble in water. Actienges. f. Anilinfabr. Ger. Pat. 280,646, July 15, 1913.

1-AMINO-4-HALOGENANTHRAQUINONE-2-SULPHONIC acids are heated with aromatic amines, water, and copper or copper compounds, with or without substances capable of combining with acids; the sulpho group remains intact, whilst the halogen is replaced by an arylamino residue.—A. S.

Vat dyestuff; Production of a bluish-green —. L. Cassella und Co. Ger. Pat. 280,711, Sept. 12, 1913.

1-AMINOANTHRAQUINONE is heated to a high temperature with *o*-chlorobenzaldehyde in presence of copper or a salt having a similar action, and a substance capable of combining with acid and with or without a diluent. The product is soluble with difficulty in organic solvents. It dyes cotton fast bluish-green shades from the vat.—A. S.

Acridone-like condensation products of the anthraquinone series; Preparation of —. L. Cassella und Co. Ger. Pat. 280,712, July 10, 1913.

2-NAPHTHOQUINONE-3-CARBOXYLIC acid is condensed with an aminoanthraquinone in which the ortho-position to the amino group is free, and the product is treated with a condensing agent capable of eliminating the elements of water.—A. S.

Vat dyestuffs; Preparation of —. L. Kalb. Ger. Pat. 280,787, March 26, 1913.

1,1'-DINAPHTHYL-8,8'- or -2,2'-dicarboxylic acid, or their derivatives such as esters, chlorides, or nitriles, or nuclear substitution products of these compounds, are treated with acid condensing agents, *e.g.*, sulphuric acid or aluminium chloride. The products are vat dyestuffs. The simplest one is a quinone of the composition, $C_{22}H_{14}O_2$, having the ketone groups in the amphi-position.—A. S.

Anthracene derivatives [dyestuffs]; Preparation of —. M. Kardos. Ger. Pat. 280,839, Jan. 30, 1913.

ACEANTHRENEQUINONE or one of its halogen-substitution derivatives is treated with hydroxylamine or a substance capable of yielding it. The products dye wool yellow shades from an acid bath, and their alkali salts may be used for the preparation of lakes.—A. S.

Vat dyestuffs of the anthracene series; Preparation of —. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 280,840, June 25, 1913. Addition to Ger. Pat. 268,505 (this J., 1914, 195).

INDAZOLES derived from *o*-diazomethylantraquinones are treated with condensing agents other than the halogens or substances capable of yielding halogens, specified in the chief patent, *e.g.*, with concentrated sulphuric acid or metallic chlorides. The products are in some cases identical with those obtained previously.—A. S.

Sulphonic acids of aromatic aminothiazoles; Preparation of —. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 281,048, June 24, 1913.

DEHYDROTHIOLOLIDINE, its homologues or substitution products, or the corresponding Primulines, are sulphonated by heating with sulphuric acid to a high temperature. The products are different from the sulphonic acids hitherto known, prepared by the action of fuming sulphuric acid. The azo dyestuffs prepared from the new dehydrothiothiolinesulphonic acid are faster to light and usually of a deeper colour than analogous dyestuffs from the known sulphonic acids of dehydrothiothiolidine.—A. S.

Indigo series; Preparation of oxidation products of the —. Farb. vorm. Meister, Lucius, und Brüning. Ger. Pat. 281,050, Oct. 14, 1913. Addition to Ger. Pat. 276,808.

THE product described in the chief patent (this J., 1914, 1151) is also obtained when indigo in neutral aqueous suspension is oxidised with permanganate. It is different from dehydroindigo (Ger. Pat. 216,889; this J., 1910, 207). Analogous products can be obtained from homologues and substitution products of indigo. —A. S.

Anthraquinone dyestuffs soluble in water; New blue —. Actienges. f. Anilinfabr. Fr. Pat. 473,208, April 10, 1914. Under Int. Conv., July 14, 1913.

SEE Ger. Pat. 280,646 of 1913; preceding.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Nitration of cellulose and decomposition of nitro-cellulose by acids and alkalis. Meissner. See XXII.

Nitration of cellulose, with recovery of the acids. Dreger. See XXII.

PATENTS.

Retting fibrous materials; Method and apparatus for —. J. K. Toles, San Francisco, Cal., Assignor to W. R. Brown, Detroit, Mich. U.S. Pat. 1,133,590, March 30, 1915. Date of appl., April 23, 1913.

FLAX straw bales are placed in a horizontal tank partly filled with circulating fluid; the tank is then filled with fluid under pressure, with or without the addition of retting bacteria, and the fluid is heated and continuously circulated under pressure to effect the complete retting of the flax. Means are provided in the circuit to remove gummy substances and acid, produced by fermentation from the retting fluid.—F. W. A.

Retting of flax straw and the like. M. A. Adam, London, W. J. Fennie, Dromara, Ireland, and The Fibre Corporation, Ltd., London, Eng. Pat. 745, Jan. 10, 1914.

THE loosening of fibres of fibrous plants, such as flax, is accelerated by heating the water used for retting to 37° C. for 8 to 24 hours; the further progress of the reaction is unaffected by reducing the temperature to 20° to 25° C.—F. W. A.

Animal fibres and fabrics; Combinations of salts for the treatment of —. [Wool-scouring]. R. Vidal. Fr. Pat. 473,183, Sept. 9, 1913.

A SULPHITE or thiosulphate is dissolved in its water of crystallisation and a powdered anhydrous alkali carbonate, sulphide, or hydroxide is stirred in; mixtures of hydrated alkali salts may be dissolved in their water of crystallisation; polysulphides rich in carbonates are prepared by fusing an excess of an alkali carbonate with sulphur. Any of these combinations may be used for the scouring of animal fibres with or without soap. — J. F. B.

Gas-tight membrane [for balloon fabrics] and method of making it. Deutsche Gasglühlicht A.-G. (Auerge). Fr. Pat. 473,421, June 13, 1914. Under Int. Conv., Aug. 6, 1913.

THE pellicles formed on the surface of cultures of micro-organisms are freed from water by pressure, treated with oil or with an emulsion of oil and albuminoid substances (containing *e.g.*, linseed oil, soap, glycerin, and gelatin), dried in the air and varnished. Increased strength may be given by mercerising the pellicles with alkali solution before the treat-

ment with oil. Several pellicles may be united, or they may be given a backing of textile fabric.
—C. A. M.

Artificial silk from cellulose acetates: Manufacture of—E. Dammann. Fr. Pat. 473,126, June 6, 1914. Under Int. Conv., June 11, 1913.

ARTIFICIAL threads or ribbons are prepared by squirting an original solution of the crude products of the acetylation of cellulose (*i.e.*, without previous isolation of the cellulose acetate) into a coagulating bath composed of a solution of caustic soda (5%) saturated with a salt, such as sodium chloride or sulphate.—J. F. B.

Artificial threads and other products: Process of precipitating viscose for the manufacture of—H. Lange and G. Walther. Fr. Pat. 473,256, June 9, 1914. Under Int. Conv., June 19, 1913.

VISCOSE is squirted into a coagulating bath containing a bisulphite compound of an aldehyde, or a reduction product of such compound, *e.g.*, a sulphonylate, or a bisulphite compound of a ketone, or products of condensation obtained by combining phenols or naphthols with aldehydes and sulphites, with or without the addition of inorganic or organic salts, or sugars.—J. F. B.

Paper, paper pulp, or the like; Strainers for use in the manufacture of—S. Milne, Edinburgh. Eng. Pat. 9315, April 15, 1914.

IN a rotary drum strainer, in which the material passes through the drum from the outside to the inside, the vibrating diaphragm is situated inside the drum and is suspended from a bar passing through the trunnions and supported by spring-plates at each end. The diaphragm vibrates in the strained stuff, and the exterior of the drum is provided with combs or scrapers which sweep the impurities forward and discharge them over the side of the vat automatically.—J. F. B.

Paper pulp; Process of manufacturing—H. Dolter. Fr. Pat. 472,868, Aug. 22, 1913.

THE vegetable matter taken from the stomachs of ruminants at slaughterhouses is digested with the gastric juices at 38° C. until the non-cellulose matters are dissolved. The juices drained from the pulp may be employed for the digestion of the spent fibrous residues of tanning, colouring, or medicinal materials.—J. F. B.

Paper and other absorbent materials: Process for sizing and colouring—E. Fues. Fr. Pat. 473,405, June 12, 1914. Under Int. Conv., June 23, 1913, and May 19, 1914.

PAPER or other material is sized by dipping in a pseudo-solution containing a precipitable sizing agent, a precipitating agent, and a protective colloid combined in a single bath, to which a colouring matter may also be added. Suitable sizing agents are: soaps of fatty or resin acids, shellac, albumin, casein, etc.; salts of aluminium may be used as precipitating agents, and solutions of glue or gum arabic as protective colloids.
—J. F. B.

Construction of steam-heated drying cylinders [for textiles]. Eng. Pat. 8401. See 1.

Manufacture of coal briquettes with sulphite-cellulose waste lye as binding material. Ger. Pat. 280,455. See 11A.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Colouring matters on cotton; New—G. G. Hepburn. J. Soc. Dyers and Col., 1915, 31, 119—120.

THE new colours are obtained by treating, on

the fibre, bases containing primary or secondary amino-groups, other than primary monoamines of the benzene series, with a hypochlorite bath. Dried prints obtained by using a mixture containing 24 grms. of dianisidine, 13 c.c. of hydrochloric acid (132.5 c.c.=1 grm.-mol.), 600 grms. of tragacanth thickener, made up to 1000 grms. with water, gave reddish-brown shades on immersing in sodium hypochlorite solution (3 grms. of active oxygen per litre) for 15 to 30 seconds. Printing colours for Auramine O Conc., Night Blue, Methyl Violet 10B, Rhodamine 6G, Extra, New Methylene Blue N, Methylene Violet 3RA, and Azine Green, are prepared from 25 grms. of the dyestuff, 200 grms. of acetic acid (6° B., sp. gr. 1.045), 600 grms. of tragacanth thickening, and 175 grms. of water. The fents are washed and soaped. No development of colour occurs on replacing the hypochlorite by hydrogen peroxide.
—F. W. A.

PATENTS.

Azo dyestuffs on the fibre: Production of red insoluble—Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 280,371, June 18, 1913.

THE fabric is printed with a mixture containing *p*-nitrodiazobenzene 2.1-naphtholsulphonate, or an analogous compound, dissolved in water in presence of an alkali or an alkaline salt; the colour is developed by drying and then treating with water or acid reagents. *Example*. The printing paste is composed of 170 grms. of *p*-nitrodiazobenzene 2.1-naphtholsulphonate and 60 grms. of borax dissolved in 245 grms. of water and mixed with 420 grms. of gum tragacanth solution (60:1000), 40 grms. of barium chloride solution (1:10), 40 grms. of sodium acetate, and 25 grms. of Para soap PN. After printing, the material is dried, treated in a bath of acetic acid (50 grms. of 50% acid per litre) at 60° C., washed, and soaped.—A. S.

Prints on fabrics: Process of obtaining—O. Neuberger, Frankfurt, Germany. U.S. Pat. 1,135,043, April 13, 1915. Date of appl., Feb. 27, 1914.

FOR obtaining designs on fabrics, reduction dyestuffs, or their leuco-compounds, finely ground with varnish or oil, are applied by means of the lithographic printing process. This may be preceded by an impregnation of the fabric with a solution of an alkali, with or without reducing agents, and the dyestuff may be mixed with part of the reducing agents. The prints are developed by steaming in presence of an alkali and reducing agents.—F. W. A.

Fabrics, threads, cords, etc.; Process for rendering waterproof—S. Alexander and P. Waterhouse, New Mills. Eng. Pat. 23,709, Dec. 8, 1914.

THE material is passed successively through soap solution, a solution of an iron or copper salt, and potassium bichromate solution. The fabric remains waterproof after washing. It is preferable to use the chromate solution at 30° C. for woollens and 100° C. for other goods.—F. W. A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sodium and potassium chlorides; Solubility of mixtures of—in solutions of hydrochloric acid. W. B. Ilicks. J. Amer. Chem. Soc., 1915, 37, 844—847.

THE solubility in aqueous hydrochloric acid of sodium and potassium chlorides from a mixture of these salts decreases rapidly as the concentration

of the acid increases. The following values were obtained at 25° C. :—

HCl.	NaCl.	KCl.	Ratio K:Na.
%	%	%	
0	10.95	10.90	0.73
3.61	10.45	7.58	0.95
17.16	3.56	3.80	1.42
20.65	2.03	2.86	1.87
32.73	0.18	1.27	9.57

The decrease is much more rapid for sodium chloride than for potassium chloride, and in 16.2% acid the solubilities are the same (4.4%). The acid of constant boiling-point (20.3%) dissolves 2.9% of potassium chloride and 2.2% of sodium chloride. It is not considered practicable to separate the two salts commercially by fractional crystallisation from aqueous hydrochloric acid.

—J. R.

Hypochlorites; Penot's method of analysing — J. Clarens. Ann. Chim. Analyt., 1915, 20, 81—84.

ALL hypochlorite solutions contain chlorites, and these react with hypochlorous acid to form chlorates and chlorine peroxide. This accounts for the lower results (about 2%) obtained by Penot's method of titration with sodium arsenite solution with starch-iodide paper as indicator, as compared with those calculated from the amount of gas liberated by interaction with hydrogen peroxide, or by Mohr's modification of adding an excess of arsenite and titrating with standard iodine solution. The following modification gives correct results:—The volume of arsenite solution required in Penot's original method, is added at once to the hypochlorite solution; the liquid will still give a blue colour with the starch-iodide paper, and the titration is completed with the standard arsenite solution till the paper ceases to turn blue (see also p. 530).—C. A. M.

Pearls; Studies on — E. Beutel. Oesterr. Chem.-Zeit., 1914, 17, 240—242. Z. angew. Chem., 1915, 28, Ref. 72.

PEARLS contain, on the average, 92.5% CaCO_3 , the remainder being water and conchiolin, an organic substance allied to the proteins. The yellowing and loss of lustre of pearls is due in part to wear of the surface and in part to agglutination of the microscopic surface structure by skin secretions. Deterioration due to the first cause cannot be remedied, but the lustre can be at least partly restored by treatment with suitable fat solvents to remove the skin secretions.—A. S.

Boric water-glass. W. Ackermann. Chem.-Zeit., 1915, 39, 225—226.

A MIXTURE of boric acid and borax containing 1 Na₂O to 3—4 B₂O₃ is moistened and heated on a water-bath until it forms a clear syrupy liquid, which is transparent, colourless, and highly adhesive; it remains syrupy for a long time provided that it is not shaken too much. The syrupy form may be restored by adding a little water to the solid and heating. The product is particularly useful as a flux in hard soldering, as it flows readily, adheres well to metal, does not froth or swell like borax, and can be removed without any trouble from the soldered article. Like silica water-glass, boric water-glass forms, on drying, an opaque mass soluble with difficulty in water, but the boric product resembles more closely phosphoric water-glass obtained by fusing microcosmic salt in platinum.—A. B. S.

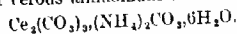
Lead and manganese; Volumetric determination of the higher oxides of — with titanium trichloride. L. Moser. Chem.-Zeit., 1915, 39, 245—247.

Lead peroxide and red lead. A weighed quantity

(0.2—0.5 gm.) is mixed with water (100 c.c.), the mixture is boiled to expel dissolved oxygen, an excess of standard titanium trichloride solution is rapidly added, with shaking, in a current of carbon dioxide, and the violet solution, whilst still warm, is titrated in the usual way with ferric chloride, in the presence of potassium thiocyanate or methylene blue as indicator, in the latter case deducting from the volume of titanium solution required for reduction that corresponding to the indicator added. The strength of the titanium solution is determined in the same manner, by boiling 100 c.c. of water for 5 minutes, adding a measured volume of titanium chloride solution, in a current of carbon dioxide, and titrating with ferric chloride. If iron be present, it must be determined by decomposing the peroxide with hydrochloric acid, boiling off chlorine, and titrating with titanium chloride; the volume of titanium solution found is then deducted from that used in the determination of active oxygen. (Chlorides, sulphates, and calcium have no influence on the reaction. *Manganese dioxide.* The very finely powdered material (0.1—0.3 gm.) is mixed with a large excess of titanium chloride solution, in a current of carbon dioxide, and about an equal volume of recently boiled hydrochloric acid (sp. gr. 1.19) rapidly added. The mixture is boiled gently and agitated until solution is complete, 4—5 drops of methylene blue solution are added, and the excess of titanium solution is titrated, deducting also that corresponding to the indicator added. The same method is adopted in standardising the titanium solution, whilst iron is determined and allowed for as above.—F. SODN.

Magnesium chloride as a mineral former. 11. *Uranium-cerium-blue and the existence of constitutive colouring.* *Magnesia-red and magnesia-green.* K. A. Hofmann and K. Höschele. Ber., 1915, 48, 20—28. J. Chem. Soc., 1915, 108, ii, 165—166.

WHEN anhydrous magnesium chloride is used as a solvent for the crystallisation of metallic oxides (this J., 1914, 199), uranium oxide crystallises with cerium oxide, the product having a deep blue colour. The coloured substance is produced by heating a dry mixture of cerium and uranyl sulphates with excess of magnesium chloride in a covered crucible for 15 hours. The resulting deep blue cubic crystals can be separated from the magnesia by reason of their relative stability towards dilute acids. The composition of this uranium-cerium-blue varies slightly, but agrees approximately with that of a compound of uranium dioxide with a bimolecular proportion of cerium dioxide. Uranium dioxide itself can be obtained in a crystalline condition by fusing sodium uranate with magnesium chloride in an analogous manner. A similar deep blue compound of uranium and cerium dioxides can also be obtained by precipitating an aqueous solution of uranyl and cerous nitrates with excess of ammonia or dilute potassium hydroxide solution; the precipitate is at first yellow, but soon changes to a denser blue solid. This result is attributed to a reduction by the primarily produced cerous hydroxide, followed by combination of the resulting dioxides. The blue compound can be isolated by treatment with ammonium bicarbonate solution, which removes excessive uranium dioxide as uranium ammonium carbonate, but if this process is too prolonged the blue compound undergoes decomposition with formation of doubly refracting crystals of cerous ammonium carbonate,



It was not found possible to obtain analogous results by wet methods with other metals in place of uranium. By heating cobalt sulphate with

magnesium chloride in a porcelain crucible, octahedral crystals of "magnesia-red" can be obtained more easily than by the earlier process (Hedvall, this J., 1914, 429); the addition of magnesia is not necessary, as it is produced during the heating. By a similar process nickel sulphate gives rise to green, octahedral crystals ("magnesia-green"). These crystals are mixed crystals of the two oxides. In experiments with manganese, complications arise on account of atmospheric oxidation. Attention is drawn to the ease with which, on fusion with magnesium chloride, many basic oxides react with formation of a chloride which sublimes, leaving a residue of magnesium oxide.

Metal ammonias of chlorates, bromates, and iodates; Stability of the —. Thermal dissociation and explosion. F. Ephraim and A. Jahnsen. Ber., 1915, 48, 41—56. J. Chem. Soc., 1915, 108, ii., 166—167.

THE metal-ammonias of the chlorates, bromates, and iodates are easily obtainable, but in the case of the derivatives of the two former, investigation of the dissociation curves is limited by the explosive nature of the compounds at higher temperatures. The explosion temperature of the metal-ammonias derived from the chlorates of the metals zinc, nickel, and copper, coincides approximately with the temperature at which the dissociation pressure becomes equal to the atmospheric pressure, and that this may not be a chance coincidence is confirmed by the fact that under increased pressure the explosion temperature is raised. With the metal-ammonias derived from the bromates, on the other hand, no marked difference is observable between the explosion temperature under ordinary atmospheric pressure and in sealed vessels. In the case of the metal-ammonias of the iodates of copper, nickel, zinc, and cadmium, dissociation occurs at relatively low temperatures, although explosions cannot be produced in the open atmosphere, but only in sealed vessels, the requisite temperatures being between 210° and 219° C. The metal-ammonias of the chlorates and bromates, in addition to exploding on heating, can also be exploded by shock.

The following compounds are described: Copper-tetrammine chlorate, deep blue needles; copper-hexammine chlorate, deep blue; nickel-hexammine chlorate, blue crystals, m.pt. near 180° C.; zinc-tetrammine chlorate, colourless crystals; zinc-hexammine chlorate; cadmium-hexammine chlorate, colourless crystals; cadmium-tetrammine chlorate; cobalt-hexammine and cobalt-tetrammine chlorates were unstable, as also was a manganese-ammine chlorate of unknown ammonia content. There were also obtained: Copper-tetrammine bromate, blue needles; nickel-hexammine bromate, violet, crystalline powder; zinc-tetrammine bromate, crystalline powder; cadmium-tetrammine bromate, crystalline powder; anhydrous copper iodate (that described by Ditte, J. Chem. Soc., 1892, 62, 1388, is the monohydrate), brown; copper-tetrammine iodate dihydrate, blue prisms; copper-pentammine iodate; nickel-pentammine iodate, violet; nickel-pentammine iodate trihydrate, reddish-violet crystals; zinc-tetrammine iodate, colourless needles; cadmium-tetrammine iodate, microscopic prisms.

Ammonium salts: Action of — on mercuric iodide. I. I. Guareschi. Atti R. Accad. Sci. Torino, 1914-1915, 50, 231—236. J. Chem. Soc., 1915, 108, ii., 167—168.

WHEN a mixture of mercuric iodide with a little ammonium bromide is heated in a long, narrow tube of hard glass, violet iodine vapours are evolved, the aqueous extract of the cold mass giving an intense coloration with starch solution.

The reaction, which is shown clearly by as little as 0.0001 grm. of mercuric iodide, is due to the formation and subsequent decomposition of ammonium iodide; it takes place also in solution. The presence of mercuric chloride or bromide, or lead bromide hinders the reaction, which is, however, not affected by an excess of potassium bromide. When heated with ammonium chloride, mercuric iodide yields scarcely any iodine, whilst with ammonium sulphate or nitrate much iodine is liberated, but the cold mass gives no coloration with starch solution. The reaction is given also by ammonium bichromate. Mercurous iodide and ammonium bromide yield no iodine, the reactions occurring being expressed by the equations: $\text{Hg}_2\text{I}_2 + 2\text{NH}_4\text{Br} = \text{HgBr}_2 + \text{Hg} + 2\text{NH}_4\text{I}$; $2\text{NH}_4\text{I} = 2\text{NH}_3 + \text{H}_2 + \text{I}_2$, and $\text{Hg} + \text{I}_2 = \text{HgI}_2$. The presence of mercurous iodide or bromide also prevents the reaction with mercuric iodide. Mercuric iodide is readily soluble in cold ammonium bromide solution, and if the dry residue of the liquid is heated, iodine vapour is immediately evolved. This reaction allows of the separation and characterisation of mercuric iodide when mixed with large proportions of many other insoluble red compounds; thus, mercuric sulphide (cinabar) containing only 0.1% of the iodide responds to the test. This is not the case, however, when the mixture of mercuric sulphide and iodide is heated with water and ammonium bromide, owing to the formation of ammonium sulphide, sulphur, etc. When a mixture of a little mercuric iodide with much manganese dioxide is slowly heated, iodine vapour is liberated at first, but the mercuric iodide subsequently sublimes; with rapid heating, scarcely any iodine is set free. Addition of ammonium bromide to this mixture results in the copious evolution of iodine vapour. If a mixture of mercuric iodide and antimony sulphide is heated with ammonium bromide, ammonia is liberated in large quantity and a sublimate forms, but no iodine can be detected. When this mixture is treated with aqueous ammonium bromide and the dried crystalline residue of the solution heated, faintly violet vapours form, but no reaction is given with starch; the presence of an iodide is, however, shown by addition of chlorine water.

Aluminium nitride: Sublimation and dissociation of —. F. Fichter and G. Oesterheld. Z. Elektrochem., 1915, 21, 50—54. J. Chem. Soc., 1915, 108, ii., 168—169.

ALUMINIUM nitride is usually obtained as a grey, amorphous mass, but some specimens contain rosettes of colourless, hexagonal needles. The results of experiments show that the crystals are the result of sublimation. Aluminium nitride begins to sublime in a tungsten tube at $1870^\circ \pm 20^\circ$ when under a pressure of 14 mm. of nitrogen, and at $1890^\circ \pm 20^\circ$ the sublimation is very rapid under the same conditions. The sublimation is accompanied by a partial dissociation of the nitride into its elements; the distillate settles as a crystalline deposit, which contains considerable quantities of metallic aluminium. The dissociation is more complete the lower the pressure of nitrogen, and it is still more complete when aluminium nitride is heated in hydrogen at 2 mm. pressure. When higher pressures of nitrogen are used the tungsten tube is attacked. Experiments in carbon or graphite tubes filled with nitrogen at atmospheric pressure show that sublimation occurs without the formation of metallic aluminium, but the sublimate is contaminated with aluminium carbide and carbon. When aluminium carbide is heated quickly to 2000°C. , it partly dissociates, and leaves a residue of graphite. When an arc is struck between aluminium electrodes in nitrogen, a fine, grey sublimate of aluminium nitride which contains

metallic aluminium, is formed. This product can be freed from aluminium by distillation of the aluminium at 1840° C. in hydrogen of low pressure.

Chromic oxide; Hydrous —. C. F. Nagel, jun. *J. Phys. Chem.*, 1915, 19, 331—337.

HYDROUS chromic oxide is brought into colloidal solution by caustic alkali. It can adsorb to some extent hydrous oxides of iron, manganese, cobalt, nickel, copper, and magnesium, and thus bring them also into colloidal solution. These oxides adsorb chromic oxide, and thus tend to remove it from its colloidal solution in alkali. In the presence of glycerin, hydrous iron oxide is brought into colloidal solution by alkali, and then loses its tendency to precipitate chromium oxide. By adding potassium hydroxide rapidly and in not too great excess to a solution of chromic sulphate a good chromic oxide jelly can be obtained. (See also this J., 1914, 75.)—C. A. M.

Magnetisability of the oxides of manganese, chromium, uranium, molybdenum, and tungsten. E. Wedekind and C. Horst. *Ber.*, 1915, 48, 105—112. *J. Chem. Soc.*, 1915, 108, ii., 140—141.

THE magnetisability of the oxides of manganese is very similar to that of the oxides of vanadium or titanium; the monoxide is rather more strongly magnetic than the dioxide, whilst the results obtained with barium manganate and potassium permanganate show that the susceptibility decreases with increasing valency. The mixed oxide, Mn_2O_4 , is most strongly magnetic, corresponding with Fe_2O_4 and Ti_2O_4 , whilst the sesquioxide appears to be unexpectedly less magnetic than the other oxides. Chromium trioxide is less magnetic than the sesquioxide, whilst the salt-like oxides, Cr_2O_3 and Cr_2O_5 , are about three thousand times more strongly magnetic than the former. In the cases of the sulphides, CrS and Cr_2S_3 , the susceptibility decreases with increasing valency, thus differing from the sulphides of vanadium; the greatest susceptibility is shown by the sulphide, Cr_2S_3 . Uranium di- and tri-oxides are more strongly magnetic than the metal, and show a perceptible increase in susceptibility with diminishing valency; in the case of the mixed oxide, U_3O_8 , the expected increase in magnetisability was not observed. Similar results were obtained with the oxides of molybdenum and tungsten. Barium manganate was prepared in a slightly impure state by addition of excess of aqueous barium hydroxide to a moderately concentrated solution of potassium permanganate and cautious addition of hydrogen peroxide until the solution was only faintly pink; the dark precipitate was repeatedly washed with water. Chromous sulphide, CrS , grey powder, sp. gr. at 14° C., 3.909, was obtained by heating the sesquisulphide in a stream of hydrogen for twelve hours at as high a temperature as possible. The sulphide, Cr_2S_3 , black powder, sp. gr. at 14° C., 3.558, was prepared by heating a mixture of chromium sulphide and sulphur in a current of hydrogen sulphide, the temperature being gradually raised to redness. Excess of sulphur was subsequently removed by carbon bisulphide.

Phosphorescent selenides of the alkaline-earth metals. F. Kittelmann. *Ann. Physik.*, 1915, [iv], 46, 177—196. *J. Chem. Soc.*, 1915, 108, ii., 121.

IN all active preparations of phosphorescent alkaline-earth selenides, which contained copper, manganese, bismuth, lead, silver, zinc, nickel, or antimony as the metallic "impurity," the phosphorescent light was found to show a maximum near the red end of the spectrum. The phosphorescent band has its maximum in all cases at a greater wave-length than that which corresponds with the exciting light. The upper temperature limit, above which the selenides are inactive, is in

general lower than for the corresponding sulphides. So far as the visible spectrum is concerned, the number of phosphorescent bands exhibited by the selenides is small in comparison with that shown by the sulphides, and the chief maxima are displaced towards the red end of the spectrum as compared with the maxima characteristic of the corresponding sulphides. The intensity and the duration of the phosphorescence are also much smaller for the selenides than for the sulphides.

Didymium group; Fractional crystallisation of the picrates of the rare earths of the —. L. M. Dennis and F. H. Rhodes. *J. Amer. Chem. Soc.*, 1915, 37, 807—815.

UPON repeated fractional crystallisation of a mixture of the picrates of the rare earths of the didymium group containing also small amounts of the elements of the yttrium and erbium groups, the members of these three groups accumulated in the least soluble, intermediate, and most soluble fractions, respectively. Yttrium could also be separated from erbium and holmium in a similar manner, but the individual elements of the didymium group were non-separable, and no concentration of neodymium or praseodymium was observed.—J. R.

Lead oxides; Determination of the higher —. J. Milbauer and B. Pivnicka. *Z. anal. Chem.*, 1914, 53, 569—581. *Z. angew. Chem.*, 1915, 28, Ref. 75.

BUNSEN's method, in which chlorine liberated from hydrochloric acid by lead dioxide is determined iodometrically, gives satisfactory results when concentrated hydrochloric acid is used, but is too complicated for ordinary use. The method of Lux (*Z. anal. Chem.*, 1880, 19, 153; see also Chwala and Colle, this J., 1911, 802), using excess of oxalic acid and then titrating the excess not oxidised, is suitable for technical purposes. Finzi and Ropuzzi's method (*Z. anal. Chem.*, 1902, 41, 741), depending upon the action of hydrazine acetate on the lead oxides in presence of acetic acid, gives high results. The authors utilise the reaction, $PbO_2 + 2NH_4OH + 2KOH = Pb(OK)_2 + 4H_2O + N_2$; no heating is required, and the results, though somewhat low, are much better than those obtained by Finzi and Ropuzzi's method.—A. S.

Lead and the end product of thorium. Part II. A. Holmes and R. W. Lawson. *Phil. Mag.*, 1915, 29, 673—688. (See this J., 1914, 1206.)

CALCULATIONS based on the assumption that the total lead found in certain minerals is the sum of the uranium-lead (radium G), the thorium-lead (thorium E), and the original lead, give the half period of decay of thorium E as about 10⁹ years. The suggestion that the end product of thorium E is an isotope of bismuth is considered unlikely, as the latter has not been detected in thorite and allied minerals. It is probable that the final product is an isotope of either thallium or polonium. It may be considered as proved that the stable uranium-lead has a lower atomic weight than ordinary lead, but the evidence in the case of thorium-lead is much less certain owing to its instability. The crude estimation of the age of a mineral based on its Pb:U ratio can now be corrected by atomic weight determinations, allowance being made for the presence of original lead and for thorium-lead; but this would barely affect the time-scale as at present constituted. —E. H. T.

Bismuth from pitchblende: α -Radiation of —. L. Meitner. *Physikal. Zeits.*, 1915, 16, 4—6. *J. Chem. Soc.*, 1915, 108, ii., 126.

ACCORDING to experiments made by Fajans and

Towara (Naturwissenschaften, 1914, 2, 685), the residues from Joachimsthal pitchblende contain a new element of the bismuth series which emits α -rays and is characterised by a half-decay period of less than 10^8 years. For various reasons this result seemed to be improbable, and the author re-investigated the bismuth residues from the above source. It was found that the α -ray activity exhibited by the bismuth is due to ionium, and that it can be completely removed by the addition of a small quantity of thorium to the bismuth solution, and subsequent separation of these elements by appropriate methods.

Radioactive substances; The gases produced by ——. Decomposition of water. A. Debiere. Ann. Phys., 1914, [ix.], 2, 97–127. J. Chem. Soc., 1915, 108, ii., 126–127.

THE author gives a summary of the results which have been obtained up to the present time in the investigation of the gases produced in the decomposition of water by radioactive substances. These results would seem to show that the chemical decomposition is due to the action of the α -, β -, and γ -rays which are emitted by these substances. It is suggested that the products of decomposition are formed in three different ways: (1) by direct collision of the charged particles with the molecules of water, (2) by local rise of temperature along the path of the particles, (3) by ionisation and subsequent interaction between the ions and other constituents of the water. The ions produced by the action of the rays on water are supposed to be similar to the ions produced in gases, and are

represented by the symbols, H_2O^+ and H_2O^- . By interaction of these ions with the hydrogen and hydroxyl ions in the water, hydrogen, hydrogen peroxide, and oxygen are formed in accordance

with the equations: $H_2O^+ + H = H + H_2O$; $H_2O^- + OH = H_2O + OH$; $2OH = H_2O_2$; $4OH = 2H_2O + O_2$.

The relative importance of the above three processes cannot be determined with any degree of certainty, but it would seem that the first and second are of greater significance for the α -rays than for the β -rays. The fact that nearly pure hydrogen is obtained in the decomposition of water by β -rays would suggest that the gaseous product is in this case due to the third process. The importance of the third process in the action of both kinds of rays is shown by a calculation of the quantity of gas which would be evolved by 1 gm. of radium in radioactive equilibrium. In this it is assumed that the number of ions formed in the water is equal to the number which would be produced in a gas. The calculated rate at which gas would be liberated is of the same order as that which has been actually observed in the author's experiments.

Electric discharges; The chemical action of ——. The role of ionisation [in fixation of nitrogen].

E. Briner. Jour. Chim. Phys., 1915, 13, 18–32.

THE chemical activity of electric discharges is due to thermal, ionic, and photochemical action, but in the fixation of nitrogen, as ammonia or nitric oxide, the photochemical action does not take part. The ultraviolet rays do not cause the formation but the destruction of these compounds, and the results obtained show that the chemical activity of the arc is principally of a thermal character and not of ionic origin.—B. N.

Carbon monoxide; Action of bromine on ——. A. Piva. Gaz. Chim. Ital., 1915, 45, I., 219–237.

USING bromine and carbon monoxide dried by means of phosphorus pentoxide, only a very small proportion of the bromine disappeared even on prolonged exposure to sunlight, e.g., 2.29% in 32

hours in one experiment. When water was added in increasing quantities, the amount of bromine combined increased: for example, with a quantity of water about the same as that of the bromine, 80% of the bromine was combined in 32 hours in presence of sunlight, and over 20% even when the mixture was protected from the light. The final reaction products are carbon dioxide and hydrobromic acid, and it is considered probable that the carbon monoxide and bromine first unite to form carbonyl bromide and that equilibrium is attained when only a small proportion of this is formed; in presence of water the carbonyl bromide is decomposed, thus disturbing the equilibrium and giving opportunity for the formation of more carbonyl bromide.—A. S.

Hydrogen arsenide; A hydrate of ——. de Forcrand. Comptes rend., 1915, 160, 467–470.

A HYDRATE of hydrogen arsenide was formed when the gas, generated by the action of water on aluminium arsenide, was compressed with a few drops of water in a Cailletet apparatus. The hydrate has a critical temperature of decomposition at $28.2^\circ C$., when its dissociation pressure, 17.5 atm., is equal to the vapour tension of liquid hydrogen arsenide. At lower temperatures the hydrate is stable under the required minimum pressures corresponding to the temperatures, for example 0.806 atm. at $0^\circ C$., 2.05 atm. at $10^\circ C$., and 6.79 atm. at $18.25^\circ C$.. The calculated heat of formation is 17,753 cal. from liquid water, and 8,238 cal. from solid water, corresponding to the formula, $AsH_3 \cdot 6H_2O$. The hydrate is closely analogous to those of hydrogen sulphide, phosphide, and selenide, and exhibits almost the same difference in physical constants from the last-named as does the hydrate of phosphine from that of hydrogen sulphide. Hydrogen antimonide also forms an analogous hydrate.—G. F. M.

Hydrogen peroxide solution; Acidity of ——. T. Callan. Pharm. J., 1915, 94, 413. (See also this J., 1915, 281.)

THE method prescribed in the U.S. Pharmacopœia for the determination of the acidity of hydrogen peroxide solution (addition of 5 c.c. of N/10 sodium hydroxide solution to 25 c.c. of the sample and determination of the excess of alkali, remaining after concentration, by titration with N/10 acid, using phenolphthalein as indicator) gives results which are about three times as high as those found by the B.P. method (direct titration with N/10 sodium hydroxide solution, using methyl-orange as indicator). The discrepancy between the results obtained by the two methods is due to the presence of phosphates in the solution (numerous samples examined were all found to contain phosphates) and to the fact that dissolved carbon dioxide is included in the "acidity" as determined by the U.S.P. method. Both methods are equally accurate, though giving widely differing results in the presence of phosphates (and probably of salts of other polybasic acids), and the method to be preferred depends entirely on what is understood by the term "acidity."—W. F. S.

Hydrazine; Anhydrous ——. III. Anhydrous hydrazine as a solvent. T. W. B. Welsh and H. J. Brodersen. J. Amer. Chem. Soc., 1915, 37, 816–824.

THE approximate solubility of 120 substances in liquid hydrazine is given, together with the action of the electric current upon the solutions. Of the metals examined, only those of the alkali group are appreciably soluble. Sulphur and iodine dissolve readily, with vigorous decomposition of the hydrazine. The solubility of chlorides, bromides, and iodides increases in the order given; the weights dissolved per c.c. of solvent in the case of the sodium compounds are 0.08,

0.37, and 0.64 grm., respectively. Metallic carbonates, oxides, sulphates, and sulphides are at the most only slightly soluble. Nitrates are generally soluble, but in some cases reaction occurs with the solvent. Ammonium compounds dissolve with the evolution of much ammonia due to a process of hydrazinolysis. Tertiary ammonium phosphate is, however, insoluble. Bismuth chloride gives a quantitative precipitation of metallic bismuth; and mercury compounds, with the exception of the insoluble sulphide, yield mercury. Cobalt and silver mirrors are produced under certain conditions, and copper and lead compounds also dissolve with some amount of decomposition.—J. R.

Hydrazine; Anhydrous —. IV. *Chemical reactions in anhydrous hydrazine.* T. W. B. Welsh and H. J. Broderston. J. Amer. Chem. Soc., 1915, 37, 825—832.

HYDRAZINE sulphide precipitates cadmium and zinc as sulphides from solutions of their salts in anhydrous hydrazine, and the process may be effected quantitatively by titrating the hydrazine sulphide with the cadmium or zinc solution until the yellow colour just disappears. Metallic sodium precipitates cadmium, zinc, and iron, but not magnesium, calcium, or barium from similar solutions. Zinc, copper, tin, and aluminium do not react and magnesium, calcium, and lithium react only slightly with anhydrous hydrazine. Reactions take place in this solvent similar to those which occur in liquid ammonia, water, and other dissociating solvents.—J. R.

Flame reactions. IV. Salts in oxygen and chlorine flames. Bancroft and Weiser. See XXIII.

PATENTS.

Alkali nitrates; Process of decomposition of —. [Manufacture of nitric acid and alumina.] Soc. Anon. des Poudres et Nitrates. Fr. Pat. 473,433, June 13, 1914. Under Int. Conv., June 16, 1913, and June 12, 1914.

A MIXTURE of sodium or potassium nitrate and alumina or bauxite is treated with a current of superheated steam, at a temperature (250°—400° C.) below the decomposition point of the nitric acid which is evolved, and the residue is extracted with water to produce a solution of alkali aluminate, from which pure alumina may be obtained. The reaction is facilitated by adding calcium carbonate (10%) to the charge, and fusion is prevented by introducing 10—15% of crude aluminate from a preceding operation; a barium or strontium compound may also be added to convert silica into an insoluble silico-aluminate.—F. SODX.

Salt; Apparatus for the manufacture of —. H. Frasch, Assignor to United Salt Co., Cleveland, Ohio. U.S. Pat. 1,125,998, Jan. 26, 1915. Date of appl., Apr. 18, 1892.

THE brine is fed into a long shallow pan and heated by steam pipes arranged in the form of transverse grids with spaces between them. Steam is supplied to each coil from a trunk above and the condensed water drains to a main below, and is returned to the boilers. The pan is divided by partitions into heating, settling, and evaporating sections enclosed under one hood. Vapours leave by shafts in the roof and the salt is raked to draining boards through doors in the sides of the cover. In the first section the brine is heated to boiling and concentrated to saturation; calcium sulphate is precipitated, and the liquor passes to the second compartment, which is not directly heated. Slight evaporation and cooling take place and a small quantity of salt is deposited and carries down the suspended impurities, which settle out as the liquid passes slowly to the third

portion for concentration. The pure salt deposited is raked up the gently sloping sides of the pan to draining boards along its margins enclosed under the same hood. After a time it is shovelled to traps and runs down shoots to storage bins below the pans, where the heat radiating from the bottom of the pan further dries the product.

—W. H. H. N.

Alkali chloride solutions; Electrolysis of —. Hoesch und Co. Sulfitcellulosefabrik. Ger. Pat. 280,556, Sept. 6, 1913. Addition to Ger. Pat. 279,998 (this J., 1915, 355).

A PART or the whole of the electrolyte is circulated from the anode compartment, through the diaphragm, into the cathode compartment, and thence to the saturation chamber.—A. S.

Bleach-chamber. A. V. Suchy, Assignor to Niagara Alkali Co., Niagara Falls, N.Y. U.S. Pat. 1,126,586, Jan. 26, 1915. Date of appl., Jan. 22, 1914.

THE chamber floors are cooled by water circulating under them in special structures of reinforced concrete.—W. H. H. N.

Lime and gas; Manufacture of —. R. Pearson, and The Chalk Fuel Power Gas and Bye-Products Corporation, Ltd., London. Eng. Pat. 5734, March 6, 1914.

BRIQUETTES composed of chalk, small coal, solidified tar, and naphtha oil, are heated in steam on a bed of incandescent fuel in a generator. The products are lime, and a gaseous mixture rich in hydrocarbons, suitable for lighting, heating, etc. Ground peat, or peat and chalk, may be used instead of the coal.—E. H. T.

Barium oxide; Process for producing —. S. B. Newberry and H. N. Barrett, Baybridge, Ohio. U.S. Pat. 1,133,392, Mar. 30, 1915. Date of appl., Aug. 15, 1914.

BARIUM sulphate is mixed with barium oxide, the mixture is pulverised till 90% passes a 100-mesh sieve, and then heated, with agitation, to 2700° F. (1480° C.) or over, until the sulphate is converted into oxide with evolution of sulphur dioxide and oxygen.—W. H. H. N.

Volatile compounds and process of producing same. [Calcium carbonitride.] Volatile magnesium compounds and process of producing same. [Magnesium carbonitride.] Alkali-metal silicates; Process of decomposing —. [Alkali carbonitride and aluminium carbonitride.] S. Pewcock, Philadelphia, Pa., Assignor to Agricultural Research Corporation, New York. U.S. Pats. (A) 134,411, (B) 134,412, and (C) 134,413, April 6, 1915. Date of appl., April 18, 1914.

(A) A MIXTURE of carbon and a suitable oxide, such as calcium oxide, is heated in an atmosphere containing nitrogen, substantially free from active oxygen, to a temperature at which a volatile carbonitride is produced. (B) A mixture of magnesium oxide and carbon is heated in presence of nitrogen, e.g., in an atmosphere of producer gas, keeping the partial pressure of carbon monoxide below 400 mm., and the carbonitride produced, which is volatile at 1500° C., is collected in a medium free from active oxygen. The product is a soluble white powder, giving a white precipitate with solutions of lead and silver salts, and yielding ammonia with hot water. (C) A finely divided mixture of carbon and a mineral containing an alkali metal and aluminium is heated, in an atmosphere of nitrogen, to a temperature sufficient to produce volatile carbonitrides of these metals, the partial pressure of the reaction products being maintained below 350 mm. The product con-

denses to a powder and reacts with water at 200° C. to give ammonia, alkali carbonate, and alumina.—F. SODX.

Aluminium pernitrides; Process of making——. S. Peacock, Philadelphia, Pa., Assignor to Agricultural Research Corporation, New York. U.S. Pat. 1,134,414. April 6, 1915. Date of appl., April 18, 1914.

A FINELY divided mixture of aluminium phosphate and carbon is heated, in presence of nitrogen, to a temperature above that of formation of volatile carbonitrides and below that at which aluminium nitride is formed, preferably to about 1700° C., the partial pressures of the reaction products being maintained below 400 mm., and the volatile product is collected.—F. SODX.

Radioactive liquids; Economical production of large quantities of——. H. Farjas. Third Addition, dated Aug. 20, 1913. to Fr. Pat. 456,990, July 1, 1912 (this J., 1913, 1028, 1108).

LIQUIDS are rendered radioactive by passing them intermittently or continuously through vessels filled with balls (preferably of small diameter) prepared from radioactive material as already described. Air is treated by passing through a cylinder fitted with a fan and containing an intercepting zone of such radioactive balls.—F. SODX.

Hydrogen; Manufacture of——. J. L. Buchanan, Bromborough, and E. B. Maxted, Rock Ferry. Eng. Pat. 6477, March 14, 1914.

A MAXIMUM yield of hydrogen is obtained by passing carbon monoxide and steam over catalysts consisting of or containing metallic couples. An iron-copper couple may be made by heating iron oxide with sodium carbonate, washing with water to remove caustic alkali, drying, reducing the iron oxide with hydrogen, then cooling, moistening with copper nitrate solution, and heating in a current of hydrogen. The resulting couple is heated to 500° C., and carbon monoxide with an excess of air passed over it. A silver-iron couple is also very effective.—E. H. T.

Hydrogen; Process of manufacturing——, by alternate action of a reducing gas and steam upon heated ferruginous matter. Soc. l'Hydrogène. Fr. Pat. 472,373, May 19, 1914. Under Int. Conv., May 21, 1913.

To prevent accumulation of oxidisable impurities introduced into the ferruginous mass by the gases employed for heating and reducing, the preliminary heating is effected by means of water-gas burnt with an excess of air, and the subsequent, periodical heating with air alone.—E. H. T.

Gases; Methods of and means for effecting the combination of——. [Isolation of nitrogen from the air.] The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, U.S.A. Eng. Pat. 6739, March 17, 1914.

TWO or more gases are caused to interact in a heated porous tube, one being led through it, and the other diffusing into it through the porous walls. By passing air through the tube and causing a reducing gas to diffuse through the walls, nitrogen (containing less than 0.5% of oxygen) can be isolated. The tube is made preferably of aluminium, and is heated electrically by a metallic wire encircling it. The whole is embedded in sand in a furnace. The reducing gas, e.g., hydrogen, passes through the sand into the walls of the tube.—E. H. T.

Nitrogen and oxides of nitrogen; Process for the simultaneous production of——. Farb. v. m. Meister, Lucius, und Brüning. Second Addition, dated April 17, 1914 (under Int. Conv., April 22, 1913), to Fr. Pat. 453,845, Jan. 31, 1913 (this J., 1913, 791, and 1914, 483).

THE air used for oxidising the ammonia is replaced partly or entirely by an equivalent quantity of oxygen.—E. H. T.

Gases; Producing chemical action in——. [Manufacture of oxides of nitrogen.] C. S. Bradley, New York. U.S. Pat. 1,134,583, April 6, 1915. Date of appl., May 1, 1909. Renewed Sept. 2, 1914.

OXIDES of nitrogen are produced by introducing a mixture of nitrogen and oxygen into an enclosed chamber, heating the gases to reaction temperature by electric arcs, and immediately and rapidly discharging the products into an area of reduced pressure, whereby the temperature is reduced below that of dissociation.—W. F. F.

Thermochemical reactions and nitrogenous by-products; Manufacture of materials for producing——. N. Lecegne. (A) Fr. Pat. 472,958, Aug. 27, 1913, and (B) First Addition, dated Aug. 30, 1913.

(A) BAUXITE is strongly heated by the combustion of a highly compressed mixture of gas and air within its pores, and is then slowly cooled by gradually reducing the supply of combustible gas whilst maintaining that of air. The product is a porous mass of corundum which resembles platinum in its ability to bring about thermochemical reactions; its power of separating, decomposing, or condensing gases varies with the pressure of the gaseous mixture employed in its preparation. Granular corundum is obtained by submitting a mixture of bauxite and carbon to combustion in a current of compressed air. In either case, the nitrogen present in the gas used is partly converted into nitric oxide, which may be recovered as nitric acid, and nitrides of the bases are also produced, whilst the formation of cyanogen is observed when a mixture of bauxite and carbon is heated by the combustion of air and coal gas. (B) Corundum, specially suitable as a refractory material, is obtained in compact form by feeding successive charges of crushed bauxite into a shaft furnace heated by an oxidising mixture of compressed air and producer gas; or in granular form by heating an agglomerated mixture of crushed bauxite and carbon in the presence of air, injected under pressure at the lower part of the furnace so as to cool the finished product as it descends. Nitric acid is obtained as a by-product by treating the residual gases.—F. SODX.

Graphitisation of carbon articles; Method of quick——. J. W. Brown, Lakewood, Ohio, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,133,259, Mar. 30, 1915. Date of appl., May 6, 1912.

THE carbon articles are placed in the graphitising furnace with their largest surfaces in contact and at right angles to the direction of the current. Pressure is applied in the direction of the current.—W. H. H. N.

Chlorine gas; Process and apparatus for compressing, drying, and transferring——. J. W. Aylsworth, East Orange, Assignor to Halogen Products Co., Glen Ridge, N.J. U.S. Pat. 1,134,432, April 6, 1915. Date of appl., Nov. 6, 1913. Renewed Sept. 2, 1914.

SEPARATE volumes of chlorine gas are entrapped between volumes of sulphuric acid and forced under pressure through a rotating helical pipe coil.

whereby the compressed gas is delivered into a receiver in a dry condition. The acid is subsequently returned to the feed chamber through a vertical U-tube below the two vessels; the height of the U-tube is such that the maximum pressure in the receiver does not force the level of the acid below the bend in the tube.—C. A. M.

Carbides of silicon and by-products [potassium and aluminium carbides]; Process for producing — S. Peacock, Chicago, Ill., Assignor to Agricultural Research Corporation, New York. U.S. Pat. 1,134,081, Mar. 30, 1915. Date of appl., July 17, 1912.

FINELY divided felspar is mixed with carbon and heated to the required temperature under reduced pressure in an electric furnace. The volatile carbides of potassium and aluminium are pumped off and burnt in excess of air to oxides. The residue of silica and carbon is heated to the temperature of formation of silicon and finally of carborundum.—W. H. H. N.

Hydrogen peroxide solutions; Process for preventing decomposition of — A. Farago, Budapest. U.S. Pat. 1,134,323, April 6, 1915. Date of appl., April 20, 1914.

SEE Ger. Pat. 275,440 of 1913; this J., 1914, 831.

Hydrogen; Process of making — R. P. Pictet, Wilmersdorf, Germany. U.S. Pat. 1,134,416, April 6, 1915. Date of appl., May 29, 1911.

SEE Fr. Pat. 421,838 of 1910; this J., 1911, 542.

Hydrogen; Manufacture of — G. Claude, Assignor to Soc. l'Air Liquide (Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude), Paris. U.S. Pat. 1,135,355, April 13, 1915. Date of appl., Mar. 25, 1913.

SEE Fr. Pat. 453,187 of 1912; this J., 1913, 791.

Boron nitride; Process of making — G. Weintraub, Lynn, Mass., Assignor to General Electric Co. U.S. Pat. 1,135,232, April 13, 1915. Date of appl., Feb. 3, 1913.

SEE Eng. Pat. 16,468 of 1913; this J., 1914, 421.

Combinations of salts for the treatment of animal fibres and fabrics. Fr. Pat. 473,183. See V.

Process of treating natural silicious materials. [Production of cement and potassium salts.] Fr. Pat. 473,279. See IX.

Bipolar electrode of fused ferric oxide, especially for the production of chlorates. Ger. Pat. 281,511. See XI.

VIII.—GLASS; CERAMICS.

Glass; Some temperature refraction coefficients of optical — J. W. Gifford. Roy. Soc. Proc., 1915, A. 91, 310—321.

A TABLE is given of the temperature refraction coefficients ($\lambda = 5270$) for a rise of 1°C ., the normal temperature being 15°C .. The quantities vary from 0.0000004 for "dense barium crown" to 0.0000105 for borosilicate flint. In the case of Schott's Fluor Crown, of which only one prism could be cut, the coefficient was -0.0000035 . It is the only glass the author has examined in which the sign is negative, i.e. in which the refractive index in air decreases with increase of temperature. Quartz and fluorite behave in the same way.—W. C. H.

PATENTS.

Ovens for earthenware, sanitary ware, bricks, etc. E. V. and H. D. Dunn, Haslington. Eng. Pat. 8219, April 1, 1914.

EX OVENS for pottery ware and bricks, the "bags"

are fitted with an inner lining of fireclay, made in one piece or constructed of quarries, and built into the wall of the oven so as to be flush with the inner face of the latter.—A. B. S.

Furnace for the cupellation or refining of silver, glass blending, enamelling, etc. Eng. Pat. 7633. See X.

IX.—BUILDING MATERIALS.

Wood; Decomposition of — by fungi. C. Wehmer. Ber., 1915, 48, 130—134. J. Chem. Soc., 1915, 108, i., 197—198.

THE decomposition (dry rot) of wood by certain fungi, such as *Merulius lacrymans*, *M. silvester*, *Comophora cerebella*, and *Polyporus vaporarius*, was studied. 100 parts of well-rotted pine wood (51% C) yielded 50 parts of carbon dioxide, water, etc., 7.5 parts of a water-soluble substance (46—51% C), consisting of a brownish-black, glossy varnish or a dull coal-like powder. 17.5 parts of an alkali-soluble substance (64% C) composed of shiiny, blackish-brown particles, and 25 parts of insoluble peat-like residue (60% C) in the form of compact brown masses showing the almost unchanged structure of wood under the microscope. Amorphous substances with successively decreasing oxygen content and strongly increasing carbon content can be isolated from rotten wood; the humus soluble in water contains relatively more oxygen than the original wood. The "acidity" of rotten wood is due to the presence of humus, free organic acids being absent. This "acidity" can be neutralised by alkali, but is restored by boiling with water, the rotten woody fibre merely absorbing the alkali superficially. Sugars are readily attacked by *Merulius*, and the unaffected portions remain as humus.

Determination of iron disulphide (pyrites) in soils. Rodt. See XVI.

PATENTS.

Plaster retarder from bean vines; Manufacture of — D. Y. Strauss, Artesia, Cal., Assignor to California Retarder and Fibre Co., Los Angeles, Cal. U.S. Pat. 1,131,901, April 6, 1915. Date of appl., March 26, 1914.

THE liquid and soluble constituents of Lima bean vines are extracted, and the extract is partially evaporated and absorbed in an earthy absorbent such as lime.—F. SODX.

Silicious materials; Process of treating natural — [Production of cement and potassium salts.] H. E. Brown. Fr. Pat. 473,279, June 10, 1914. Under Int. Conv., Aug. 29, 1913.

A MIXTURE of a natural silicate, such as felspar, and a calcium compound (preferably calcium carbonate), in proportion to give 40—55% CaO in the cement subsequently produced, is melted in a non-reducing or oxidising flame, and, after volatilisation of the alkali, which is recovered, the fused product is disintegrated and converted into a hydraulic cement by treating with a solution of alkaline-earth salts, e.g. magnesium sulphate. The calcium carbonate in the first stage of the process may be partly replaced by sufficient calcium chloride to react with the alkali present.—F. SODX.

Cement making. H. Abraham, Bound Brook, N.J., and H. W. Haines, New York, Assignors to Impervious Products Co. U.S. Pat. 1,134,573, April 6, 1915. Date of appl., March 9, 1910.

SEE Fr. Pat. 426,889 of 1911; this J., 1911, 1061.

Wood; *Method of colouring* — L. Doyen, Paris. U.S. Pat. 1,135,167, April 13, 1915. Date of appl., Jan. 17, 1913.

SEE Eng. Pat. 1063 of 1913; this J., 1913, 912.

Manufacture of materials for producing thermochemical reactions and of nitrogenous by-products. Fr. Pat. 472,959, and Addition. See VII.

Process of impregnating porous substances. U.S. Pat. 1,134,436. See XIII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Ferrous oxide and carbon; Reactions between — and between carbon monoxide and iron. V. Falcke. Z. Elektrochem., 1915, 21, 37—50. J. Chem. Soc., 1915, 108, ii., 169—170. (Compare this J., 1913, 365.)

Using the same apparatus as previously employed, the author studied the above-mentioned reactions at temperatures from 600° C. upward, and also examined the gaseous products obtained when the reaction mixtures were dissolved in hydrochloric acid. Three varieties of graphite and five varieties of amorphous carbon were used. They were subjected to prolonged purification, and were then analysed and their densities obtained. The solid mixtures examined were introduced into the apparatus in the form of compressed pellets. Below 650° C. none of the highly-purified forms of carbon react with ferrous oxide, and above this temperature the various varieties behave differently, but fall into three groups. Sugar charcoal and charcoal obtained by the action of carbon monoxide on sodium are very inert, and a vigorous reaction does not take place until a temperature of 800° C. has been reached, and in these cases an equilibrium pressure was not obtained. Charcoal obtained by burning acetylene in chlorine, and charcoal from petroleum reacted more easily, showing a vigorous action at 650° C. The three forms of graphite react similarly, and the great capacity of graphite for this reaction is attributed to the fact that the reactions commence slowly, and increase gradually to a definite limiting value, after which they proceed at a constant rate until the reaction is complete, which is taken to imply that a contact reaction occurs in the solid mixture which precedes the evolution of gas, and which is probably one of solution or direct combination. The reaction products of the action of carbon on ferrous oxide contained pure iron, but no hydrocarbons were obtained when the solid product was dissolved in hydrochloric acid. In the case of the action of carbon monoxide on iron, it was found that when carbon monoxide was led into the apparatus until a considerable amount had been absorbed by the iron and the equilibrium pressure set up at 600° C., the product on solution in hydrochloric acid gave large volumes of saturated hydrocarbons, chiefly ethane, but no solid carbon was left. On the other hand, when iron was heated in a stream of carbon monoxide, or when iron was allowed to absorb large quantities of carbon monoxide and then heated in a vacuum, and the product dissolved in hydrochloric acid, no hydrocarbons were evolved, but a residue of carbon remained behind. The work and views of Schenck and his collaborators (this J., 1905, 803; 1907, 692) are criticised.

Platinum, palladium, and gold; Determination of — [in ores]. A. M. Smoot. Eng. and Min. J., 1915, 99, 700—701.

THE lead buttons obtained by the ordinary pot assay from two or more fusions, are scorified together

and the resulting button cupelled at a high temperature, at least six times as much silver as the combined weight of platinum, palladium, and gold present being added during the process. The silver bead is parted with nitric acid (1:6, followed by 1:1), the residue, consisting of the gold and part of the platinum, is washed with water, dissolved in *aqua regia*, and the solution reserved. By the addition of hydrochloric acid to the nitric acid solution, silver is precipitated and the platinum left in solution, but the resulting silver chloride is pink and contains palladium; the silver precipitate is therefore scorified and cupelled with lead, the bead dissolved in nitric acid (1:6), and the silver re-precipitated with hydrochloric acid, the separation being repeated until the silver chloride obtained is no longer pink. The filtrates from the silver chloride precipitations are added to the *aqua regia* solution previously obtained, the liquid evaporated to dryness, the residue treated with 5 drops of hydrochloric acid and 40 c.c. of water, any insoluble matter ($\text{AgCl} + \text{PbCl}_2$) being rejected unless of a pink colour, when it is re-treated for the recovery of palladium as before. Gold is precipitated from the solution by boiling after the addition of 3 grms. of oxalic acid; the precipitate is allowed to stand overnight before filtration, being then re-dissolved and re-precipitated several times if the ore is rich in platinum and palladium. The final gold precipitate is cupelled with lead and about six times its weight of silver, the bead parted, and the gold weighed as usual. To the combined oxalic acid filtrates, 5 c.c. of hydrochloric acid is added, the liquid diluted to 150 c.c., heated to boiling, and treated while hot with a rapid current of hydrogen sulphide; the precipitate of platinum and palladium sulphides is filtered off, dissolved in *aqua regia*, the solution evaporated to dryness twice with hydrochloric acid, the residue treated with 2 or 3 drops of hydrochloric acid and 2 c.c. of water, and the solution treated with ammonium chloride as usual for the separation of platinum. To avoid the mechanical loss caused by igniting the platinum-ammonium chloride, the latter is dissolved in boiling 5% sulphuric acid, the boiling solution treated with hydrogen sulphide, the precipitate filtered off, the filter burned at a low temperature, the residue scorified with lead, with the addition of six times as much silver as the weight of platinum present, the button cupelled, the bead parted with concentrated sulphuric acid, and the residual platinum weighed. To the filtrate from the ammonium chloride precipitation, an excess of dimethylglyoxime (at least seven times the amount of palladium present) dissolved in hydrochloric acid (2:1) is added, the liquid diluted to 250—300 c.c., heated for 30 mins., allowed to stand overnight, and filtered through a Gooch crucible. After being washed first with dilute hydrochloric acid (1:1) to remove the excess of precipitant, then with water and alcohol in succession, the precipitate is dried at 110°—115° C. and weighed; it contains 31.686% Pd.—W.E.F.P.

Silver; Determination of — in ores and concentrates containing platinum and palladium. A. M. Smoot. Eng. and Min. J., 1915, 99, 701.

THE lead button obtained by ordinary pot assay is dissolved in dilute nitric acid, the insoluble residue is filtered off, washed, and re-scorified with lead, and the button treated with dilute nitric acid as before. To the combined nitric acid solutions, sufficient standard sodium chloride solution is added to precipitate the silver, and, if the latter is small in amount, about 0.5 c.c. of sulphuric acid also, the liquid is stirred, allowed to stand until the supernatant liquid is clear, and then filtered through double papers. The filter is then incinerated and the residue scorified with

lead, the button being cupelled direct if the palladium content of the ore is small, or, otherwise, re-dissolved in nitric acid and the precipitation of the silver chloride repeated.—W. E. F. P.

Tetranickel triarsenide [maucherite] as a silver precipitant. C. Palmer. *Econ. Geol.*, 1914, 9, 664–674. *J. Chem. Soc.*, 1915, 108, ii., 171.

MACHERITE (*J. Chem. Soc.*, 1913, 104, ii., 516) from Eisleben and Mansfeld in Thuringia, and temiskamite from Elk Lake, Ontario (this *J.*, 1914, 261), are completely decomposed by a solution of silver sulphate, the nickel and arsenic passing into solution in the ratio given by the formula Ni_4As_3 . One molecule of this compound deposits seventeen atoms of metallic silver in the form of arborescent crystals. It is suggested that temiskamite is identical with the earlier-described maucherite, and that the true formula is Ni_4As_3 , rather than Ni_3As_4 . Samples of the mineral from these three localities (containing 98.82, 95.84, and 92.76% Ni_4As_3 , respectively) had sp. gr. at 25° C. 7.81, 7.80, and 7.73 respectively. Niccolite (NiAs) is also capable of depositing silver from a solution of a silver salt, but smaltite (CoAs_2), cobaltite (CoAsS), and arsenopyrite (FeAsS) are strongly resistant. These reactions have a bearing on the enrichment in silver of mineral veins containing nickel arsenides.

Copper leaching; Some of the problems in —. L. D. Ricketts. *Min. and Eng. World*, 1915, 42, 679–682.

INVESTIGATIONS made with the low-grade, oxidised copper ore of Ajo, Ariz., U.S.A. (an eruptive granite containing about 1.5% Cu, together with salts of iron and aluminium) showed that a high extraction of copper could be obtained by leaching with dilute sulphuric acid, the crushed ore (maximum size 6-mm. cube) being readily permeated and yielding a clear solution; the extraction was dependent more on the time of contact than on the strength of acid. With copper at 12 c. (6d.) per lb. and the cost of mining 25–50 c. (1s. 0½d.—2s. 1d.) per ton of ore, leaching with dilute sulphuric acid, followed by precipitation of copper with pig iron or spongy iron, was commercially practicable. It was more advantageous, however, to recover pure copper direct from the solution by electrolysis, for which purpose the leaching was conducted so that the rate of increase of iron and alumina in the solution was slow, and the iron content of the electrolyte maintained below 0.75% by periodically agitating a portion of the liquid with copper oxide and compressed air; by this method 1.5 lb. of sulphuric acid was lost per lb. of copper produced. Very promising results were obtained by leaching the ore with a sulphuric acid solution of iron and aluminium sulphates, passing the liquid through a tower for the absorption of sulphur dioxide from furnace gases, and electrolysis the solution, the iron and aluminium in the latter acting as depolarisers and catalysts. In the author's opinion this method will probably prove the most economical.—W. E. F. P.

Copper [in brass]; Rapid electrolytic determination of —. W. Thecl. *Chem.-Zeit.*, 1915, 39, 179.

COPPER may be determined in brass by dissolving 1 gm. of the sample in 8.5 c.c. of sulphuric acid (1:4) and 1.5 c.c. of nitric acid (sp. gr. 1.4), heating the solution to expel nitrous vapours, then diluting it to 25 c.c., and electrolysis with a current of 2 amps.; the whole of the copper is deposited within 1 hour.—W. P. S.

Copper and aluminium; Thermochemistry of the compounds of —. L. Rolla. *Gaz. Chim. Ital.*, 1915, 45, 1, 192–196.

THE heats of formation of the bromides of copper

and aluminium from the metals and from the three compounds, Cu_2Al , CuAl , and CuAl_2 , by reaction with a solution of bromine in potassium bromide, were determined calorimetrically, and from the results the heats of formation of the intermetallic compounds were calculated: the values obtained were CuAl_2 , +23.29; CuAl , +32.38; Cu_2Al , –13.33 Calories per kilo.-mol. The formation of all three compounds is accompanied by a diminution in volume, the deviations of the observed specific volumes from those calculated according to the law of mixtures being CuAl_2 , 3.8%; CuAl , 2.9%; Cu_2Al , 4%.—A. S.

Nickel; Electrolytic deposition of — [from chloride solutions. R. Riedel. *Z. Elektrochem.*, 1915, 21, 5–19. *J. Chem. Soc.*, 1915, 108, ii., 182–183.

IN the extraction of copper from sulphides containing nickel, large quantities of nickel chloride solution are obtained, from which the nickel is removed electrolytically. The author has investigated the conditions of electrolysis at the ordinary temperature in the presence of free hydrochloric acid and in the presence of acetic acid. The current efficiency and the conditions under which a good coherent metallic deposit are obtained in the two cases are compared. The current efficiency over the range 100–80% has been quantitatively determined in its relation to the concentration of hydrochloric acid and acetic acid. In the case of hydrochloric acid, carbon anodes, and in the case of acetic acid, both carbon and nickel anodes were used. The current efficiency decreases with an increase in the acid concentration. With hydrochloric acid it is 80% when the acid concentration has reached 0.07%, whilst in the case of acetic acid this value is only reached with 1.0% of acid. In consequence of this high concentration of acetic acid, its use would remove the necessity of a very troublesome controlling of the acid concentration during the electrolysis, which is always necessary when hydrochloric acid is used. In order that the nickel should be deposited in a usable form, it is necessary that a definite concentration of hydrogen ions should be maintained: when an operation is left to itself, the small quantity of hydrochloric acid allowable is rapidly removed, whereas the larger amount of slightly dissociated acetic acid automatically keeps the hydrogen ion concentration at the right point. The current efficiency increases with the concentration of nickel in the solution. Using a current density of 190 amperes per square metre with a solution containing 4–10% Ni, the efficiency fluctuates between 80% and 90%, and with a current density of 350 amperes per square metre it varies between 85% and 95% in a 1% acetic acid solution. To obtain a continuous coherent deposition of nickel, the current density must be kept within limits which are special for each solution, and depend on the concentration of the solution in nickel and free acid, on the nature of the free acid, the purity of the solution, and the method of stirring the liquid. A continuous stirring of the electrolysis bath is only necessary in the case where the solution becomes alkaline. Porous deposits can be avoided by using a current density which just produces the coherent deposit; a higher value may be used only with a higher concentration of nickel or of acid. The presence of many metallic ions in a hydrochloric acid solution of nickel chloride is unfavourable to the formation of a coherent deposit. The order in increasing harmfulness is Cu^+ , Cu^{++} , Mn^{++} , Fe^{+++} , Zn^{++} , and Pb^{++} . In an acetic acid solution experiments were made only with zinc and lead as impurities, since it was shown that the deposit of nickel is not so sensitive to the presence of impurities as in the case of hydrochloric acid solutions. The minute traces of foreign metals suffice in a hydrochloric acid solution to produce a spongy

nickel effect, whilst in acetic acid solutions considerable quantities of impurities may be added before any influence is shown in the nature of the deposit. If a spongy deposit is once produced, no change of the conditions of electrolysis is sufficient to bring it back to the coherent condition. As a general result of the work, it follows that in the electrolysis of nickel chloride solutions the addition of hydrochloric acid is harmful, and cannot be considered in the technical electrolysis; a weakly dissociated acid is required, and this is found in acetic acid.

Magnetisability of the oxides of manganese, chromium, uranium, molybdenum, and tungsten. Wedekind and Horst. See VII.

Boric water glass. [Flux for hard soldering metals.] Ackermann. See VII.

Action of metals on the chlorides of carbon. Zappi. See XX.

Determination of arsenic by boiling a hydrochloric acid solution with hydrazine salts and potassium bromide. Jannasch and Seidel. See XXIII.

PATENTS.

Cast-iron; Process for manufacturing Thomas —. F. Dahl. Fr. Pat. 472,696, May 26, 1914. Under Int. Conv., Aug. 1, 1913.

MOLTEN iron containing 20–25% Mn, obtained by direct reduction of manganese iron ores or mixtures in blast-furnaces, is added to molten pig iron in sufficient quantity to produce the required composition.—W. E. F. P.

Iron or steel; Carburizing —. S. S. Eveland, Bryn Mawr, Pa., Assignor to Eveland Electric Riveter Co. U.S. Pat. 1,133,626, March 30, 1915. Date of appl., April 12, 1910.

IRON or low-carbon steel is heated in a closed receptacle with fibrous vegetable waste containing carbohydrates and protein, but not starchy matter, e.g., the fibrous waste from sugar manufacture.—W. E. F.

Steel; Manufacture of —. E. Humbert. Fr. Pat. 472,429, Aug. 25, 1913.

A MIXTURE of 10 to 30% of sand and 70 to 90% of lime is melted, and carbon is added in amount equal to about 10 to 30% of the total weight of the mixture. The steel to be purified is poured on to the molten mixture, so as to transform iron and manganese silicates into an easily fusible calcium silicate.—B. N.

Steel ingots; Manufacture of sound —. K. Canaris. Fr. Pat. 472,594, May 22, 1914.

THE upper surface of the steel is cooled by water or air to produce immediate solidification, and molten steel is then introduced under pressure at the base of the ingot to fill cavities.—B. N.

Ferrosilicon product; Crystalline — and method of making the same. *Ferrosilicon product and method of continuously producing the same. Ferrosilicon alloys of definite compositions.* H. C. Harrison, Lockport, N.Y., Assignor to Electro Metallurgical Co. U.S. Pats. (A) 1,134,127, (B) 1,134,128, and (C) 1,134,129, Apr. 6, 1914. Dates of appl., July 30, Dec. 1, and Dec. 15, 1909. Renewed (A) and (B) Sept. 1, and (C) Sept. 17, 1914.

(A) A PRODUCT consisting of, or containing, bright, hard, brittle, plate-like crystals corresponding to the formula Fe_3Si_2 , is prepared by maintaining "at or above a predetermined critical temperature" a charge calculated to produce ferrosilicon containing 53–54.5% Si.

(B) Ferrosilicon of any definite composition is produced continuously as described under (A), the critical temperature increasing with the silicon content desired. (C) Ferrosilicon of definite composition and constitution, composed of "solid mixtures of definite compounds containing iron and silicon" is claimed.—W. E. F. P.

Furnaces; Gas-fired —. *Metal-heating furnace.* I. Hall, Birmingham. Eng. Pats. (A) 7238, March 23, 1914, and (B) 3036 of 1915, date of appl., March 23, 1914.

(A) IN a furnace heated by low-pressure gas, an end view of which is shown in the figure, gas is supplied to the burners through a pipe, 7, from the outlet, 13, of a regulator, 11, actuated by a thermostat, 10, in the heating chamber, 1, or in a separate chamber adjacent to it. Several heating chambers, one above the other, and each provided with a temperature-indicating device, may be used. A shield, 14, prevents the flame from impinging on the charge. (B) The gas burners, 6, are attached to bosses arranged along the top of a relatively large cylindrical chamber, 5. (See also Eng. Pats. 21,072 of 1912; 26,583 and 28,346 of 1913; 5198, 5888, and 6016 of 1914; this J., 1915, 16, 34, 231.)—W. E. F. P.

Furnace for the cupellation or refining of silver, glass bending, enamelling, etc.; Gas-fired —. L. F. Tooth, London. Eng. Pat. 7633, March 26, 1914.

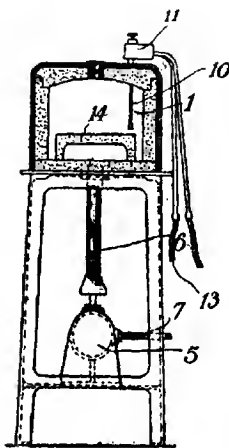
GAS burners, inclined upwards, are arranged in openings at one side of the arched combustion chamber, and exit openings at the opposite side, corresponding with the burners, extend into vertical flues connected with horizontal ones running across the furnace above the combustion chamber. The horizontal flues communicate with vertical downtake flues terminating in a longitudinal trunk connected to the chimney, and are provided at one side of the furnace with doors for the admission of secondary air and at the other with cleaning and inspecting doors.—W. R. S.

Crucible and melting pot furnaces. L. F. Tooth, London. Eng. Pat. 7635, March 26, 1914.

A TILTING furnace mounted on pivots is provided with a cranked flue which enters a hollow sleeve adjacent to one of the pivots; the sleeve communicates with a fixed uptake flue. Above the furnace is a covered preheater, pivoting upon a bracket extending from one of the standards supporting the furnace, and provided with an oblique charging spout. The cover of the preheater can be raised by cams as it is swung aside.—W. R. S.

Metallurgical apparatus [cupola furnace]. C. J. Rice, Ashland, Ky., Assignor to The Pneumatic Cupola Co., Ironton, Ohio. U.S. Pat. 1,133,317, March 30, 1915. Date of appl., July 11, 1912.

A CUPOLA furnace having a set of low-pressure



main tuyères, and below these and above the level of the molten metal a series of high-pressure purifying tuyères entering tangentially and inclined downwards.—W. R. S.

Metallurgical furnace. U. Wedge, Ardmore, Pa. U.S. Pat. 1,133,828, March 30, 1915. Date of appl., Sept. 11, 1912.

A VERTICAL furnace with superposed helical hearths projecting inwards from its outer wall.—W. R. S.

Metallurgical furnace. U. Wedge, Ardmore, Pa. U.S. Pat. 1,133,829, March 30, 1915. Date of appl., Jan. 4, 1913.

A FURNACE having a central rotating shaft with arms, independent of the rabble arms, each of which carries an electrical heating device upon its under side. The heater is connected directly with one pole and indirectly, through the supporting arm, with the other pole of a source of current.—W. R. S.

Roasting furnace; Mechanical——. A.-G. für Zink-Industrie vorm. W. Grillo, and W. Scheffzik. Fr. Pat. 473,310, May 4, 1914. Under Int. Conv., June 9 and 10, 1913.

THE FURNACE comprises one or several cylindrical or semi-cylindrical muffles, each provided with a horizontal shaft carrying one or more arms supporting a water-cooled bar, parallel to the shaft, on which are fixed interchangeable prongs for advancing the material. With cylindrical muffles, the shaft is rotated by pinions. With semi-cylindrical muffles, the horizontal shaft receives a pendulum-like movement from a rack and pinion. The muffles may be arranged in two vertical rows, and the transporting mechanism moved by two racks forming a frame, to which is attached the piston rod of a hydraulic pump. The movement of the rod is communicated to a revolving cone, forming a valve for controlling the supply and escape of the water actuating the pump, and the dead point of the latter is passed by the frame continuing for a short time in its direction of movement. The ore is delivered from a hopper on to the roof of the furnace at one end and is conveyed to the other end of the roof by scrapers fixed on an endless chain. The inclinations of the lower end of the feed hopper and of the outlet spout are regulated separately, and the lower end of the hopper is provided with a toothed cylinder for conveying the material outwards; a slide above the cylinder regulates the supply of ore. The ore is dried by its passage across the roof and is then introduced into the furnace by means of a cone furnished with teeth revolving in a funnel, the enveloping surface of the cone having an inclination different to that of the funnel. When heating the furnace with solid fuel, heated air is supplied above and below the grates, but when heating with gas, a regulated amount of the gas and pre-heated air may be introduced into each muffle.—B. N.

Nickel, copper, and aluminium, with or without steel; Alloys of——. G. A. Joyce, London. Eng. Pat. 8270, April 1, 1914.

ALLOYS which will take a high polish and do not rust or tarnish on exposure, are composed of: (1) Cu 27.5–40%, Ni 65–45%, steel 5–11%, Al 2.5–5%; (2) Cu 80–5%, Ni 17–06%, Al 2–4%. They contract considerably during cooling and hence are useful for mounting diamonds for technical purposes.—W. F. F.

[Type] metal; Melting of—— in melting pots. I. Hall, Birmingham. Eng. Pat. 12,219, May 18, 1911. (See also Eng. Pat. 15,323 of 1913; this J. 1911, 835.)

Is a melting pot provided at the bottom with a

valve through which the metal can be poured, the valve is actuated by a spindle surrounded by a tube. The upper end of the tube is open to the air above the surface of the metal, whilst the lower end is immediately over the valve; room is thus afforded for expansion of the metal, and any gases or air imprisoned by the metal escape through the tube.—W. R. S.

Ore or other solid substance suspended in a liquid; Apparatus for the settlement and classification of finely divided——. F. H. Wright, London. Eng. Pat. 18,791, Aug. 18, 1914.

A CONICAL classifier has an inner porous and an outer impermeable wall, and water is supplied to the intermediate space at a greater pressure than that of the liquid in the classifier, so as to prevent accumulation of material on the inner surface of the porous wall.—W. R. S.

Molten metal and other fusible substances; Apparatus for, and method of spraying——. M. U. Schoop, Zürich, Switzerland. Assignor to Metals Coating Co. of America, Boston, Mass. U.S. Pats. 1,133,507 and 1,133,508, March 30, 1915. Dates of appl., Feb. 19 and July 6, 1914.

Two electrodes of the fusible substance are fed towards one another at right angles, one being vibrated by electromagnetic means in series with the electrode, so that contact for the melting current is alternately made and broken. A jet of gas under pressure impinges on the point of contact of the electrodes and produces a spray of the fused material.—W. F. F.

Gases; Preventing escape of noxious—— in smelting [sulphide ores]. W. A. Hall, New York. U.S. Pat. 1,133,637, March 30, 1915. Date of appl., June 25, 1913.

THE ore is introduced continuously into the furnace, and the top layer is maintained at a temperature below that at which free sulphur will ignite, by spraying with a liquid containing water; introduction of air is avoided. Sufficient hydrogen sulphide is thus generated in the upper portion of the furnace to reduce the sulphur dioxide in the furnace gases and prevent combustion of the free sulphur produced.—B. N.

Sulphide ores; Process of preventing the escape of sulphur dioxide in smelting——. W. A. Hall, New York. U.S. Pat. 1,131,846, April 6, 1915. Date of appl., June 30, 1913. Renewed Mar. 1, 1915.

Is a process for recovering sulphur as such during the smelting of sulphide ores, the flame of a reducing gas is introduced into the furnace, at a point near the charge level, under conditions whereby the sulphur dioxide in the exit gases is reduced to sulphur; access of air to the gaseous mixture is avoided until the latter has cooled below the oxidation temperature of sulphur.—W. E. F. P.

Metal sheets or plates; Finishing——. A. Ridd, Brackenridge, Pa. U.S. Pat. 1,133,670, March 30, 1915. Date of appl., Dec. 22, 1913.

THE metal plates are placed in a box and subjected to an annealing temperature, out of contact with air. They are then removed in bulk and placed in a heat-retaining receptacle, previously heated to a lower temperature than that used for annealing, through which a heated non-oxidising fluid is passed. The sheets are finally removed, and exposed to air for oxidation.—B. N.

Metallic oxides; Apparatus for the reduction of—— with hydrogen. E. C. Kayser, Assignor to The Hydrogenation Co., Cincinnati, Ohio. U.S. Pat. 1,131,745, April 6, 1915. Date of appl., July 18, 1910.

METALLIC oxides are heated in a closed rotating

cylinder provided with fixed radial vanes forming a series of open compartments within the cylinder, while the gas for the reduction is introduced and discharged through the hollow trunnions on which the cylinder is mounted.—C. A. M.

Copper; Metallurgy of —. E. A. C. Smith, New York. U.S. Pat. 1,134,767, April 6, 1915. Date of appl., Feb. 10, 1913.

IN a cyclic process for the extraction of copper from ferruginous ore, the latter is roasted to convert the bulk of the iron into ferric oxide, leached with dilute sulphuric acid, and the solution neutralised by contact with a fresh portion of oxidised ore so as to precipitate the dissolved iron as basic sulphate and increase the copper content of the liquid. After rapid settling, the liquid is decanted, filter-pressed to remove the iron precipitate, and electrolysed to recover the copper and regenerate the acid, the spent electrolyte being then employed to complete the extraction of copper from the partly leached ore.—W. E. F. P.

Metals [copper]; Process for improving the mechanical qualities of —, notably their resistance to tensile strain. Comp. du Telium. Fr. Pat. 473,345, Sept. 18, 1913.

AN aluminate, such as spinel or cymophane, composed of silica, alumina, iron oxides, and magnesia with small quantities of lime, manganese, and water, is incorporated with the molten metal (e.g. copper) during refining.—W. E. F. P.

Aluminium; Process for directly coating — with [precious] metals. M. Canac. Fr. Pat. 472,667, Aug. 12, 1913.

ARTICLES of aluminium or an aluminium alloy are immersed in a boiling, aqueous solution of potash, brushed with milk of lime, immersed in a cold, dilute solution of potassium cyanide and then in a solution of hydrochloric acid containing the chloride of a metal (e.g. iron), and finally electroplated with the desired precious metal, each operation being followed by a washing in cold water.—W. E. F. P.

Zinc vapour; Process and apparatus for obtaining molten zinc from —. C. V. and J. M. J. Thierry. Fr. Pat. 472,879, June 2, 1914.

MIXTURES of zinc vapour and carbon monoxide, produced by the reduction of zinc ores, are passed into a chamber in the upper part of which are one or more metal frames carrying vertical carbon plates, pointed at their lower ends, and spaced 2 or 3 mm. apart. Each frame is surmounted by an asbestos plate and provided with a cover having perforations at the top. On passing through the narrow spaces between the carbon plates, the microscopic droplets of molten zinc carried by the vapours coalesce into macroscopic drops which collect on the sides of the carbon plates; liquid zinc subsequently drips from the pointed ends of the plates to the bottom of the chamber, whence it is discharged periodically. The gas, practically free from zinc, passes around the edges of the asbestos plate and thence to the openings in the cover, where it is burnt.—W. E. F. P.

Aluminium alloys. G. K. F. Axberg. Fr. Pat. 472,930, April 29, 1914.

BRASS is melted in a crucible, then cooled to a suitable temperature, and aluminium is added in small quantities. The mass is stirred whilst zinc and an alloy of magnesium and aluminium are added alternately in small quantities until the desired alloy is obtained, which is then cast. The following are examples: Al, 1 to 6 kilos., Zn, 3 to 9 kilos., alloy of Mg and Al, 2 to 6 kilos., brass, 0.1 to 1 kilo.; or alloy of Mg and Al, 3 kilos., Al, 7 kilos.,

brass 1 kilo.; or Ni, $\frac{1}{2}$ to 2 kilos., Al, 1 to 6 kilos., alloy of Mg and Al, $\frac{1}{2}$ to 3 kilos.—B. N.

Aluminium alloy; New — and process of manufacture. A. J. de Montby. Fr. Pat. 473,412, June 12, 1914.

AN alloy of Co, 2.5 grms., Ni, 10.0, Ag, 15.0, Cu, 3.5, W, 0.5, Cd, 1.0, Sn, 1.5, and Al, 76, is prepared by melting the metals in an electric furnace, in a crucible containing fluorspar, 1000 grms., powdered wood charcoal, 1000, manganese dioxide, 250, calcined magnesium sulphate, 250, and arsenious acid, 10 grms.; 100 grms. of the alloy and 900 grms. of aluminium are then heated in an ordinary furnace in a plumbago crucible lined with magnesia, and the metals mixed by stirring with a rod of retort carbon covered with magnesia.—B. N.

Metallic oxides; Process of preparing finely divided — for treatment [smelting]. F. Ohlmer. Fr. Pat. 473,044, Sept. 3, 1913.

FINELY divided metallic oxides, such as zinc oxide, are obtained in the form of dense spherical granules, varying in size from that of a grain of millet to that of a small pea, by passing through a rotating drum which is heated externally to a moderate temperature; the material is sprinkled with water or other liquid on entering the drum and leaves in a dry state at the further end. The granulated product, when mixed with carbon, may be reduced in an electric furnace in which the mixture itself constitutes the heating resistance, and sodium carbonate, or other substance increasing the conductivity of the mixture without causing fusion, may be added during the process of granulating.—F. SODN.

Ores, particularly iron ore; Process and furnace for treating — in a finely divided state. G. Grondal. Fr. Pat. 473,218, Dec. 27, 1913. Under Int. Conv., June 21 and Oct. 11, 1913.

THE finely divided and moistened ore is packed into slightly tapering open-ended receptacles, which are placed end to end and separated at intervals by similar empty chambers, each of which in turn acts as a combustion chamber. Longitudinal channels are formed in each mass of ore for the passage of heating gas. Air is introduced through the empty chamber at one end of the series, and combustible gas or powdered solid fuel into the next empty chamber; the combustion products pass through the remaining series of receptacles and effect sintering of the ore. After treatment, the receptacles are moved forward a step, that nearest the combustion chamber being moved beyond the chamber, so that only the air supply passes through it, to heat the air and oxidise and cool the ore. To reduce the ore to metal, it is mixed with a reducing agent, such as powdered coal, and the gas and air inlets are reversed, so that the ore is finally cooled in a reducing atmosphere.—W. F. F.

Metals and alloys; Process for obtaining — in a finely-divided form. A. Classen. Ger. Pat. 281,305, March 30, 1913.

GELATOSE, obtained by boiling gelatin with water for a long time, is used as a protective colloid to preserve metals in a finely-divided condition. A solution of a salt of the metal may be reduced in presence of gelatose; or metals or alloys may be finely divided by mechanical means, or otherwise, and then mixed with gelatose. Inert substances may be added to the products.—A. S.

[Steel] furnaces. N. E. MacCallum, Phoenixville, Pa. U.S.A. Eng. Pat. 10,598, April 29, 1914. Under Int. Conv., May 13, 1913.

SEE U.S. Pat. 1,106,725 of 1914; this J., 1914, 688.

Ferrochromium; Process of producing carbon-free — H. Goldschmidt and O. Weil, Essen, Germany, Assignors to Goldschmidt Thermit Co., New York. U.S. Pat. 1,136,669, April 20, 1915. Date of appl., Oct. 29, 1912.

SEE Eng. Pat. 18,671 of 1912; this J., 1913, 430.

Copper; Electrolytic process for the extraction of — N. V. Hybinette, Christiania. U.S. Pat. 1,136,424, April 20, 1915. Date of appl., May 22, 1913.

SEE Eng. Pat. 22,745 of 1913; this J., 1914, 359.

Copper-smelting furnace. W. G. Perkins, London. U.S. Pat. 1,136,834, April 20, 1915. Date of appl., Jan. 20, 1913.

SEE Eng. Pat. 27,869 of 1912; this J., 1913, 1115.

Titanium alloys and method of producing the same. H. Goldschmidt and O. Weil, Essen, Germany, Assignors to Goldschmidt Thermit Co., New York. U.S. Pat. 1,136,670, April 20, 1915. Date of appl., Oct. 29, 1912.

SEE Ger. Pat. 235,461 of 1909; this J., 1911, 1019.

Alloys; Process of making — E. D. Gleason, New York, Assignor to Neu-Metals and Process Co., Long Island City, N. Y. U.S. Pat. 1,136,909, April 20, 1915. Date of appl., Nov. 16, 1912.

SEE Eng. Pat. 8790 of 1913; this J., 1914, 488.

XI.—ELECTRO-CHEMISTRY.

Alternating current; Influence of an — on electrolysis by a direct current. (Part II.) J. C. Ghosh. J. Amer. Chem. Soc., 1915, 37, 733—752.

CURRENT of 30,000 alternations per minute used a change in the potentials of two platinum electrodes immersed in an electrolyte, but showed no effect of this kind when passed through a reversible voltaic cell. A direct current through reversible electrolytic cell was unaffected by the simultaneous passage of an alternating current, whereas with an irreversible electrolytic cell the strength of the direct current was greatly increased thereby, owing to a fall in the E.M.F. of polarisation. A similar fall occurred in electrolytic cells containing two cathodes and two anodes when the alternating current passed between the anodes or the cathodes only. In the cadmium-zinc chloride-mercury (or platinum) cell the E.M.F. of the mercury (or platinum) approached that of the zinc upon passing the alternating current.—J. R.

Chemical action of electric discharges. Role of ionisation [in fixation of nitrogen]. Briner. See VII.

PATENTS.

Furnace; Electric — J. W. Brown, Lakewood, Ohio, Assignor to National Carbon Co., Cleveland, Ohio. U.S. Pat. 1,134,817, April 6, 1915. Date of appl., Jan. 8, 1912.

THE furnace, with stationary enclosing walls, is provided with vertical upper and lower electrodes, the former being insulated from the charge by a surrounding condensing chamber, in which volatile matter from the charge is collected. The treated material is withdrawn below the lower electrode, thus causing the charge to descend around the condensing chamber and the lower electrode, and past the arc.—B. N.

Electrode of fused ferric oxide; Bipolar — especially for the production of chlorates, and electrolytic apparatus for use therewith. S. Laszczyński. Ger. Pat. 281,511, Sept. 12, 1913.

THE electrode is provided on one of its flat sides with a framework of wire gauze of iron, nickel, or the

like, embedded in the material so that the wire is left partly exposed. In use this side of the electrode is made to act as cathode, and the wire is thus protected from corrosion. In applying these electrodes to the electrolytic production of chlorates, an insoluble anode immersed in a special electrolyte in a "hind" cell is used as the first electrode of the series, e.g., an iron anode in alkali hydroxide solution or a lead anode in sodium sulphate solution may be used.—A. S.

Producing chemical action in gases. [Manufacture of oxides of nitrogen.] U.S. Pat. 1,134,583. See VII.

Electrolysis of alkali chloride solutions. Ger. Pat. 280,056. See VII.

XII.—FATS; OILS; WAXES.

Linseed; Cultivation of — in England. J. V. Eyre and E. A. Fisher. J. Agric. Sci., 1915, 7, 120—134.

THE common belief that linseed grown to yield a high quality fibre produces seeds poor in oil, was disproved by Ivanoff (Beihfte zum Bot. Centrbl., 1912, 28, 159), whose results are confirmed by the authors; the only difference between the fibre crop and the linseed crop was one of yield, not of oil content. The rate of oil formation is greatest midway between flowering and final ripening. The oil content of green seeds was found to be 21.05%; of seeds just turning brown, 30.08%; of wholly brown seeds but loose in capsule, 38.03%; of fully ripe seeds, 40.88%. Varieties of seed from foreign countries grown in Kent (Wye), Yorkshire, Devonshire, and Shropshire, produced seeds of which the oil contents were as high as those obtained from the same seeds in those countries. The best results were obtained in Kent, and the plant would probably flourish best in the southern counties. From the combined standpoints of percentage of oil in seed and yield of oil per acre, Plate seed was easily first, Steppe seed a moderate second, Moroccan third, and Dutch the poorest of the four. Comparing imported seed with seed produced from the same sample grown in England, it was found that increase in oil content is accompanied by an increase in size of seed. Repeated growth from the same stock does not entail the production of seeds with diminished oil content. Trials at Rothamsted in 1911 showed that artificial manuring had no effect upon the percentage of oil, but it increased the yield of seed and straw. A combination of nitrogen, superphosphate, and potash gave the best results.—E. H. T.

Lipase; Inactive — and the nature of its co-enzyme. N. Umeda. Biochem. J., 1915, 9, 38—52.

ROSENHEIM (J. Physiol., 1910, 40) has shown that active pancreatic lipase can be separated into two inactive fractions by filtration through filter paper; the portion remaining on the filter contains the thermostable inactive enzyme, which is restored to its original activity by the addition of the filtrate. The author's experiments show that the most active inorganic constituents of the co-enzyme are phosphates; organic substances, probably organic phosphates, are also concerned in the activation of the inactive portion.—W. P. S.

Auxo-lipase of serum. K. Tsuji. Biochem. J., 1915, 9, 53—65.

IT is known that the addition of small amounts of ox-serum to pancreatic extracts increases their power of hydrolysing fats. Results of experiments show that the substance, auxo-lipase, producing the acceleration, is non-dialysable and thermostable, and is destroyed by incineration. It is not identical with the co-enzyme of lipase (see preceding

abstract) and does not appear to have any relation to antitrypsin.—W. P. S.

Emulsification; Theory of—VI. W. D. Bancroft. *J. Phys. Chem.*, 1915, 19, 275–309.

HYDROXYL ions can be adsorbed from an alkaline aqueous solution by many organic liquids. When solid particles are shaken with water and an immiscible organic liquid, the phase into which they will tend to pass will depend upon which liquid they adsorb. If they adsorb both liquids it is probable that a homogeneous liquid phase is formed about their surfaces. The space between the two liquids into which a suspended substance wetted by them both will pass, is termed the "dineric interface." If the particles are unable to coalesce into a coherent film the emulsion that tends to form will not last long (*e.g.* copper powder, kerosene, and water). The name "interfacial" is given to substances that pass into the dineric interface of two liquids, and if suspended in one liquid they can be shaken from their suspension by the addition of a second liquid towards which they are interfacial. Winkelblech's test for colloids (this *J.*, 1906, 1177) is a means of detecting interfacial substances, and is applicable when a fairly stable emulsion is formed or when the interfacial substance is not readily brought into colloidal solution by either liquid. When an interfacial substance is withdrawn from an aqueous liquid it is probably less hydrous in proportion to the amount of surface of the other liquid. Experiments tend to confirm the view of Briggs (*J. Phys. Chem.*, 1913, 17, 296) that Winkelblech's method will detect substances in colloidal solution in the presence of dissolved substances. In the author's experiments with the method, benzene gave a faint film in the absence of gelatin; this was found to be due to the presence of traces of resins, and the test may therefore be used for the detection of such impurities in benzene.—C. A. M.

Emulsions and emulsification. F. G. Donnan. Lecture before the Royal Institution, April 30, 1915.

THE lecturer dealt with the factors determining the formation, stability, and destruction of emulsions. Emulsions of water in oil, and of oil in water were projected on the screen and their structure and the motion of the emulsion particles in an electric field was shown. The lecturer explained how the stability depended on the particles carrying electric charges, and showed how the variation of the electric charge, as dependent on the addition of acids, alkalis, and salts, affected the stability of the emulsion. Experiments were shown illustrating the effect of electric discharges in coagulating and settling dusts, fumes, and emulsions. In the second part of the lecture the part played by surface tension and surface-concentration (surface adsorption) was discussed. Experiments were shown illustrating the effect of various emulsifying agents on surface tension, and their power in producing stable emulsions. The lecturer explained how stability was caused by the production of concentrated surface layers or surface skins. Experiments were shown demonstrating the formation of such concentrated surface-layers, both at water/air and water/mercury surfaces. The stability of the fat emulsion in milk was dealt with, and a sample of synthetic artificial milk was exhibited. In conclusion, the lecturer pointed out that the two main factors determining the stability of emulsions, namely electric charge and surface layer, were also to be met with in dealing with colloidal solutions. The substances which lowered the surface tension and therefore formed concentrated surface layers (emulsifying agents), corresponded in some degree to the "protective" colloids, which play such an important part in the technical and medical applications of colloidal solutions. Reference was

also made to the possibility that the formation of surface layers may be in part due to electrical adsorption.

PATENTS.

Fats, oils, and the like; Apparatus for the separation of— from liquids and semi-liquids. E. H. Sams, London. Eng. Pat. 10,956, May 4, 1914.

THE apparatus consists of a vessel with a removable inner chamber provided at the top with two flanges to form an annular space between it and the outer vessel. The liquid is introduced into this space and passes through openings into the upper part of the inner chamber; the fat rises to the surface, and solid matter is deposited, whilst the heavier liquid issues through openings in the lower part into the outer vessel, and is run off through a siphon-like pipe.—C. A. M.

Oils or other liquid mixtures; Refining or distillation of— K. Birkeland and O. Devik, Christiania. Eng. Pat. 11,588, May 11, 1914. Under Int. Conv., May 16, 1913.

THE oil, etc., is forced through a jet into an atmosphere of gas or vapour, *e.g.* water vapour, and then into the main body of the oil, whereby an emulsion of vapour and oil is obtained. This is discharged through a reducing valve into a low-pressure vessel, where the gas or vapour escapes, and carries off volatile impurities.—C. A. M.

Fatty or other organic compounds; Process for effecting reduction of— E. C. Kayser, St. Brelade's Bay, Jersey. Assignor to The Hydrogenation Co., Cincinnati, Ohio. U.S. Pat. 1,134,740, April 6, 1915. Date of appl. Oct. 30, 1912.

FATTY or other organic compounds are heated with a catalyst (finely divided nickel) and an organic compound (borneol) capable of yielding hydrogen on contact with the catalyst.—C. A. M.

Oils, resins, and rubber; Process of deacidurising— Chem. Fabr. Griesheim-Elektron. Fr. Pat. 473,110, June 5, 1914. Under Int. Conv., June 6, 1913.

THE heated material is treated with molecular (gaseous) hydrogen, with or without pressure. The hydrogen may subsequently be freed from hydrogen sulphide and used again.—C. A. M.

Soaps and the like and the process of manufacture thereof. W. Feldenheimer, London. Eng. Pat. 7920, March 28, 1914.

THE use of an argillaceous schist known as "killas" as an admixture with soap is claimed.—C. A. M.

Soap; Manufacture of liquid colloidal— E. F. Rousseau. Fr. Pat. 472,587, Aug. 9, 1913.

HARD neutral or slightly alkaline soaps are treated in a dialysing vessel with a suitable liquid (water, aromatic infusions) at a temperature below that at which the soap would dissolve. The product is a stable emulsion capable of fixing perfumes and colouring matters.—C. A. M.

Lubricants, emulsions, and other analogous products; Manufacture of— C. Büchel. Fr. Pat. 472,655, May 25, 1914.

AN acylarylsulphonimide or one of its salts is incorporated with the substance to be emulsified. The reagent is obtained by treating an arylsulphonamide with the halogen derivative of a fatty acid. The m. pts. of fatty acids are raised by mixing with the acylarylsulphonimides, and oils and fats are made capable of absorbing more water.—C. A. M.

Manufacture of drying oils from products of distillation of mineral oils. Eng. Pat. 23,376. See IIa.

Treatment of lubricating oils and greases. Eng. Pats. 8279 and 15,040. See IIa.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

White lead paints; Report of the Departmental Committee on—

THE Departmental Committee appointed to consider the danger attendant on the use of paints containing lead was appointed in January, 1911, and its report was issued on May 5th last. That report recommends the restriction of the importation, sale, or use of any paint material which contains more than 5% of its dry weight of a soluble lead compound when determined by the following test: "If the paint or wash be mixed with water, turpentine, oil, varnish, size, or other adhesive or waterproofing substance, it shall first of all be freed as far as possible from such vehicle or adhesive or waterproofing substance by drying or by treatment with ether, petroleum spirit, alcohol, water, or other neutral solvent or solvents. If the residual substance so obtained should contain insoluble varnish matter, size, or other adhesive material which cannot be removed except by the action of reagents which affect the other constituents of the paint or wash, then the proportion of such varnish matter, size, or other adhesive material shall be ascertained by suitable means, and a deduction be made for the same from the weight of residual matter taken for the determination of the soluble lead, so that the proportion of soluble lead found to be present shall be calculated as a percentage of the dry matter free from varnish matter, size, etc. For the determination of soluble lead, a weighed quantity of the dried or dry material, freed as far as possible from oil, or other vehicle, or adhesive substance above described, is to be continually shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25% of actual or real hydrochloric acid. This solution is thereafter to be allowed to stand for one hour, and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate." It is recognised that artists' colours would have to be exempt from the 5% restriction, and also certain special branches of the general painting industry, but these exemptions would have to work under controlling regulations. The restriction, it is recommended, should not come into force until after three years from the publication of the Committee's report. The report discusses fully the alternatives to lead compounds, and deals specifically with the supplies of zinc compounds and the manufacture of zinc oxide. The Committee suggests that any legislation should also embrace powers to make regulations under the Factory and Workshops Act dealing with the linseed oil, turpentine, and other media used in all paints, the vapours of which may produce ill-effects.

Ultramarine. L. Bock. Z. angew. Chem., 1915, 28, 147—152.

The formation of ultramarines by treating zeolites with alkali sulphides (Singer, this J., 1910, 577) is considered to show that the grouping of sodium, aluminium, and silica in the ultramarine molecule is similar to that in the zeolites, and this view is further supported by the fact that the sodium, both in ultramarines and zeolites, may be replaced by other metals (Wunder, this J., 1912, 998). The

relationship between blue, green, purple, and red ultramarines is discussed, and possible constitutional formulae are proposed; but the state of combination of the sulphur in the various products is regarded as still doubtful. Pyrometer readings taken during the process of burning ultramarine showed a well-marked maximum in the temperature curve. A higher burning temperature could be used with mixtures rich in alumina than with those rich in silica. It is thought that ultramarines rich in alumina are aluminato-silicates, whilst those rich in silica approximate more closely to double silicates, and that the sodium is less readily replaced in the latter than in the former; the existence of isomeric ultramarines containing $-SNa$ or $-SONa$ groups attached to aluminium or silicon respectively, is considered probable. —F. SOON.

Phenol-formaldehyde condensations using casein as contact substance. H. Kuhl. Chem. Ind., 1914, 37, 559—561. Z. angew. Chem., 1915, 28, Ref., 71.

In the preparation of resinous condensation products by heating mixtures of cresol, formaldehyde, and casein (see Fr. Pat. 136,720 of 1911; this J., 1912, 115; also Ger. Pat. 280,618; following), the casein acts as a contact substance as well as a filling material. Resinous products cannot be obtained by heating mixtures of cresol and formaldehyde alone. The lacquers obtained by dissolving the resinous products in alcohol, dry very rapidly and also accelerate the drying of ordinary varnishes. They exhibit pronounced bactericidal action. When mixed with an alcoholic solution of celluloid they yield, on drying, tough elastic masses capable of replacing celluloid in the production of artificial leather. —A. S.

Volumetric determination of the higher oxides of lead and manganese with titanium trichloride. Moser. See VII.

Determination of the higher lead oxides. Milbauer and Pivnicka. See VII.

Magnesium chloride as a mineral former. Uranium-cerium blue and the existence of constitutive colouring. Magnesia red and magnesia green. Hofmann and Höschele. See VII.

PATENTS.

Dyestuff; Composition containing artificial—, and process of making same. F. Reissmann, West Point, N.Y. U.S. Pat. 1,134,486, April 6, 1915. Date of appl. Feb. 6, 1914.

THE product obtained by the action of stannous chloride on "oil of saffrol" with or without the addition of sulphur chloride, is dissolved in a mixture of acetone, benzol, and methyl alcohol. —F. W. A.

Primer and varnish and process of preparing same. Paint and varnish. A. Eichler, New York. U.S. Pats. (A) 1,133,432 and (B) 1,133,433, Mar. 30, 1915. Dates of appl., Sept. 12, 1913 and April 11, 1914.

(A) POLYMERISATION products of coumarone are melted at about 160°C. and incorporated by heating with a liquid hydrocarbon solvent, e.g., oil of turpentine, and the resulting uniform product is allowed to cool. (B) Polymerisation products of the coumarone and indene groups are incorporated with linseed oil, with or without the addition of a volatile solvent. —C. A. M.

Gum [resin]; Purified—, and process of obtaining the same. W. H. Bradshaw, Brooklyn, N.Y. U.S. Pat. 1,133,790, Mar. 30, 1915. Date of appl., April 25, 1911.

THE resinous by-product obtained in the purifica-

tion of Pontianac and other gums, is treated with a 5% solution of sugar at about 100° C. to remove objectionable impurities.—C. A. M.

Condensation products of phenol and substances containing the methylene radicle; Manufacture of — L. V. Redman, Chicago. Eng. Pat. 9291, April 14, 1914. Under Int. Conv., Feb. 24, 1914.

CONDENSATION products containing over 25% free phenol are obtained by the interaction of an excess of a phenolic compound with hexamethylene-tetramine in absence of water. For instance a mixture containing phenolic groups and methylene groups in the ratio of about 1.5:1 is heated to start the reaction, and when evolution of ammonia stops (180° C.), the mass is again heated to drive off the rest of the nitrogen. The resulting product may be converted into an infusible, insoluble substance in any suitable way, e.g., by heating gently with a sufficient quantity of a substance containing the methylene group, with or without a small proportion of ammonia. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 3496, 3497, and 3498 of 1911 and 6363 of 1912; this J., 1912, 347; 1913, 436.)—C. A. M.

Cresol, casein, and formaldehyde; Preparation of a soluble condensation product from — H. Kühl. Ger. Pat. 280,648, Aug. 21, 1913.

CRESOL and casein are heated with formaldehyde, with or without a small quantity of potassium carbonate, in an autoclave at 3–5 atmospheres pressure. For example, 250 grms. of granular casein is soaked in 500 grms. of cresol until a uniform mixture is obtained. This is mixed with 400 grms. of formaldehyde, heated in an autoclave until a pressure of 3 atmospheres is attained, and kept at this pressure for 10 mins. The product may be dissolved in alcohol to form a varnish.—A. S.

Porous substances; Process of impregnating — W. A. Beatty, New York, Assignor to H. H. Smith and J. D. Dusenberry, New York, and T. A. Witherspoon, Washington, D.C. U.S. Pat. 1,134,436, April 6, 1915. Date of appl., Aug. 26, 1913.

THE substances are heated and a partial vacuum is created within their pores. They are then impregnated with a melted synthetic gum obtained as a condensation product in the interaction of dihydroxydiphenyldimethylmethane with formaldehyde (or of other phenols, ketones, and aldehydes), and are finally heated under pressure.—C. A. M.

Rust-preventives; Manufacture of — MannesmannröhrenWerke. Fr. Pat. 472,884, June 2, 1914. Under Int. Conv., Feb. 5, 1914.

OILS or mixtures of oils and resins are treated with sulphur or sulphur chloride, and the condensation products dissolved in a suitable solvent (e.g. petroleum oil, carbon tetrachloride). The solutions are used alone or after the addition of other products such as coal tar, asphaltum, etc.—C. A. M.

Process of desulphurising oils, resins, and rubber. Fr. Pat. 473,110. See XII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Castilloa rubber from India. Bull. Imp. Inst., 1915, 13, 17–18.

Two samples of Castilloa rubber from India, consisting of small, irregular balls of dark-coloured scrap rubber, gave the following results on analysis:

caoutchouc, (a) 81.6, (b) 60.9; resin, 12.4, 34.3; proteins, 4.7, 3.7; and ash, 1.3, 1.1% respectively, on the dry washed rubber. The rubber was obtained from trees grown experimentally from seed sown in 1907. Sample (a), from male trees, was superior both in composition and physical properties, and would be worth about 1s. 6d. per lb., with fine hard Para at 2s. 6d., and fine plantation Para at 2s. 4d. per lb. Sample (b), from female trees, would be worth about 1s. 3d. per lb.—A. S.

Rubber from Dominica. Bull. Imp. Inst., 1915, 13, 18–20.

Hevea brasiliensis thrives well in Dominica and its cultivation is being extended; about 200 acres were planted with it in 1912. Three samples of Para rubber and one of Funtumia rubber, prepared at the Botanic Station, Dominica, gave the following results on analysis:—

	Para rubber.			Funtumia rubber.
	1	2	3	
	%	%	%	%
Loss on washing (moisture and impurities)	0.3	0.2	0.4	1.2
Dry washed rubber:—				
Caoutchouc	93.5	94.2	93.4	84.6
Resin	3.5	3.3	4.4	8.6
Proteins	2.7	2.2	2.0	6.4
Ash	0.3	0.3	0.2	0.2

The three samples of Para rubber, viz.: No. 1, thin biscuits of pale rubber, No. 2, thin biscuits of pale to light brown rubber, and No. 3, thin biscuits of dark brown, smoked rubber, were valued at 2s. 1d., 2s., and 2s. 3d. per lb. respectively, with first-quality biscuits at 2s. 4d., and first-quality smoked biscuits at 2s. 6d. to 2s. 7d. per lb. The rubber was somewhat soft and weak, and a little inferior to samples of Para rubber from Dominica examined previously (this J., 1910, 1907; 1913, 203). The Funtumia rubber, thin rough biscuits of light brown rubber, was valued at 2s. per lb. (Nov., 1914).—A. S.

Rubber solutions vulcanised by the ultra-violet rays; Contribution to the study of — A. Helbronner and G. Bernstein. Rubber Industry, London, 1914, 156–163. (See this J., 1913, 615, 919; 1914, 653.)

THE vulcanisation of rubber in solution in presence of sulphur, under the influence of the ultra-violet rays, was studied. A thin layer of the rubber solution, on an endless band, was carried beneath a cylindrical quartz mercury-vapour lamp, provided with a cooling jacket, and the vulcanised solution was afterwards removed by a scraper. The strength of the rubber when used as a cement was determined by measuring the load required to separate two layers of canvas united by means of the vulcanised solution. The strength and viscosity of the rubber solutions before exposure to the rays varied inversely as the percentage of sulphur employed. The amount of combined sulphur in the vulcanised solutions varied very little for concentrations of rubber up to 6%, but fell very rapidly above that point (the added sulphur being kept constant at 5% on the solution). The amount of combined sulphur and the strength of the vulcanised solutions increased with the amount of sulphur used up to 6–7%, and then diminished. The thickness of the layer of solution employed was varied according to the colour of the rubber, and it was found advisable to allow a margin of 40% above the thickness indicated by the spectroscopic for complete absorption of the rays. Curves are reproduced showing the depolymerising effect of the ultra-violet rays on a

solution of unworked Ceylon rubber—which showed complete depolymerisation (as measured by cementing strength) in seven seconds—and, on the other hand, the repolymerisation of solutions of well-worked rubber containing sulphur, the strength in this case, after 54 seconds' exposure, almost reaching that of the original unworked, unexposed rubber. The vulcanised solutions were permanent, but tended to undergo further vulcanisation after removal from the direct influence of the rays.

—E. W. L.

Vulcanisation. G. Bernstein. *Rubber Industry*, London, 1914, 164—166.

The following conclusions are drawn as a result of experimental studies of the process of vulcanisation, both by the ordinary methods and by means of actinic rays (see preceding abstract). In vulcanisation, rubber is first depolymerised, then repolymerised in the presence of sulphur, which acts as a catalyst, combination of sulphur with rubber being a subsidiary and secondary reaction. Unless the physical conditions attending vulcanisation are the same in each case, the "coefficient of vulcanisation" is not a measure of the degree of vulcanisation. In cold vulcanisation the reaction is chemical, and a definite chemical product is formed. In vulcanisation by the agency of heat or light the question is not definitely settled, but it is not a case merely of adsorption of sulphur by rubber.—E. W. L.

Balata; The production of —. W. Ter Laag. *Caout. et Gutta-percha*, 1915, 12, 8619—8620.

The author refers to a number of errors in the literature relative to the production of balata, and describes the processes now employed. In Venezuela the trees are ringed with cuts about a foot apart, and are then felled. The latex is collected in vessels placed underneath the trunk, and from it block balata is prepared by boiling. In Demerara the trees are tapped and not felled, the latex being collected at the foot of the tree, then placed in troughs ("dahris") made of twigs plastered with clay and leaves and allowed to evaporate; successive layers of balata are removed from the surface, when of sufficient thickness, and dried. The technical value of the product depends upon its degree of compactness, which in its turn is influenced by the course of the drying process.

—E. W. L.

PATENTS.

Rubber; Reclaiming —. O. A. Wheeler, Assignor to E. D. and B. Loewenthal, Chicago, Ill. U.S. Pat. 1,135,236, April 13, 1915. Date of appl., Oct. 36, 1912.

See Fr. Pat. 452,482 of 1912; this J., 1913, 706.

Caoutchoucs and other colloidal matters; Purification of natural and regenerated —. C. P. Bary, Assignor to H. Debaugé, Paris. U.S. Pat. 1,136,462, April 20, 1915. Date of appl., Feb. 3, 1912.

See Fr. Pat. 426,457 of 1911; this J., 1911, 968.

Process of desulphurising oils, resins, and rubber. Fr. Pat. 473,110. See X11.

Purified gum [resin] and process of obtaining the same. U.S. Pat. 1,133,790. See X111.

XV.—LEATHER; BONE; HORN; GLUE.

Leather; Nigerian and Somaliland —. A. Seymour-Jones. *Leather Trades' Review*, 1915, 48, 146—150. *J. Royal Soc. Arts*, 1915, 63, 531—532.

SHEEP skins and goat skins are tanned in Nigeria and Somaliland. For depilation, which takes 24

hours or less, the goods are treated in an alkaline bath and subsequently scraped with a blunt knife. The alkali is sometimes only wood ashes, but in Nigeria, "toka," which contains 18.5% CaO and 66% SiO₂, is widely used. Lime is used by the Somalis. Bates are made from the excreta of the "kairo" bird (*Pyromelana afra*) or of domestic fowls. Many natives use instead a drench made from the "dousa" husk. In Nigeria the pods of *Acacia arabica* are used as a tanning material. The tannin is allied to divi-divi and produces a soft white leather. The Somalis use the leaves and young branches of the "watta" bush (*Osyris abyssinica*) or barks from two kinds of acacia. The watta is by far the best material, and colours the leather only slightly. The red dye largely used is from a variety of sorghum, known as "karrandeffi," of which the stems contain a substantive dyestuff of the same type as that present in red sandalwood. The stems are pounded and treated with a solution of potash obtained from hark ashes. The resulting red liquid is rubbed into the skins, which are then washed with water containing a little lime juice, and finally dried in the sun. Less frequently the leather is dyed yellow or green.—F. C. T.

Velvet leather; Manufacture of —. J. W. Dyer. *Leather Trades' Review*, 1915, 48, 26—28.

A METHOD is described for making velvet leather of which the colour will be fast both to rubbing and to water. Persian sheep skins are buffed on the flesh side, then wetted down, and drummed at 35°C. with a solution containing 2% of borax on the dry weight of the skins. After 30 mins. the goods are washed in warm water and sumached for 1 hour. After washing and striking out, they are ready for dyeing. In dyeing, which is done in the drum, it is essential to secure complete penetration. This is effected by the addition of ammonium acetate to the dye liquor. No additions of dye to the solution should be made during the dyeing, as this causes irregular colour when the goods are afterwards huffed. The author gives full details, including recipes for particular colours.—F. C. T.

Colouring of horn. E. Beutel. *Z. angew. Chem.*, 1915, 28, 170—173.

THE bleaching of horn by means of hydrogen peroxide (Margold, Zink, and Beutel; *Oesterr. Chem. Zeit.*, 1913, 38, 21) requires careful supervision, and is unsuitable for use on a small scale. It results in the decomposition of the sulphur compounds present in unbleached horn, which react with neutral lead nitrate solution.

Lead, mercury, and manganese compounds, and also nitric acid, are used in the staining of horn. Unbleached horn reacts with neutral solutions containing 15 to 26% of lead nitrate to form lead sulphide, producing an ebony colour after several days' immersion. The coloured horn is afterwards immersed in a bath containing 5% of hydrochloric acid. The addition of 1% of Flavophosphine to the lead nitrate bath colours the horn in such a manner that it appears to be covered with a network of gold wires. Bleached horn is attacked by an alkaline solution of lead nitrate, which reacts with the horn substance. As horn rapidly loses its polish in alkaline baths, the surface forming a gelatinous mass which solidifies to a vitreous mass on exposure to air, care is needed to obtain a level colouring. A suitable mixing is obtained by grinding to a paste with water one part of red lead, one part of slaked lime, and two parts of sodium carbonate. Translucent horn is immediately stained brown by this mixing; a tortoise-shell appearance is obtained by first treating with nitric acid, and then applying the lead mixture by means of a wooden rod. Prolonged action of this mixing colours the horn deep

black. The tortoise-shell appearance can be modified by adding tin oxide to the mixing. Red stains are obtained by means of a 2% solution of Magenta or Crocein. When brown or black stains are required, the horn is treated with alkali to obtain an uneven coloured surface, which is then polished. On converting the lead sulphide into chloride by immersion in hydrochloric acid (1:5), a glistening appearance is obtained. On treatment with a 4% solution of potassium bichromate, a yellow to brown colour is produced. Neutral solutions containing 10% of mercurous nitrate colour horn grey after several hours. On immersion in liver of sulphur (1:20), the grey becomes deep black, the staining being then non-poisonous. A solution of mercury in nitric acid (4:10, diluted ten times with water) colours horn brilliant red to reddish brown. A warm solution of one part of potassium permanganate in ten parts of water rapidly stains horn yellowish brown, reddish brown, and black. The colour appears to be due to manganese dioxide. The latter can be readily converted into colourless manganese salts by sulphur dioxide, sodium sulphide, or ammonium oxalate. Polished surfaces are only damaged by very prolonged action of the permanganate solution. The action of nitric acid on horn depends on the temperature and concentration; a 1:3 solution stains horn a golden yellow (xanthoprotein reaction). Alkaline solutions of silver salts give yellow, brown, and grey stains; further treatment in a bath of liver of sulphur produces black stains, in a bichromate bath brown stains. Gold chloride solutions produce red to brown stains. Although frequently recommended, silver or gold solutions possess no advantages over the cheaper methods of staining.

Aqueous solutions of dyestuffs show the same behaviour towards horn as towards wool; acid dyestuffs are most suitable, the bath being acidified, or the horn first treated, with sulphuric acid. Ponceau and Water Blue RR in admixture give level reddish brown or brownish violet shades on translucent horn; only Ponceau is absorbed by opaque horn. Metanil Yellow rapidly produces a yellow shade; in presence of only small amounts of Ponceau, an orange shade is obtained, but the addition of Water Blue does not give a satisfactory green. Direct Blue 33 mixed with an equal amount of Brilliant Crocein gives a very satisfactory violet. A 0.5% bath of Fast Yellow G to which several drops of Brilliant Crocein have been added dyes horn red, whereas addition of very small amounts of the blue give a green shade. Other dyestuffs suitable for dyeing horn are: Methyl Green cryst. 3G, Janus Green B, Fast Acid Magenta G extra, Rhodamine, Aceto-purpurine 8B, Brilliant Green (new, in crystals), Bismarck Brown G, Methyl Violet No. 0 3R, Cyanol Green B, Naphthol Green B, Diamine Grey G, Fast Green cryst. O, Eosine GGG, Tropaeoline, Acid Green G extra, Auramine, Induline, Fast Red EB, Acid Anthracene Red G, Fast Light Yellow 3G, Alizarin Saphirol B. The dye-bath should contain 0.5% of dyestuff and either sulphuric or acetic acid. For dyeing red shades the most valuable dyestuffs are Ponceau, Safranin, Eosine; for blue, Methylene Blue; for yellow, Flavophosphine; for green, Crystal Green; for violet, Methyl Violet; and for reddish brown, Brown A (Höchst). On mixing 1 to 2% solutions of these dyestuffs with 15% lead nitrate solution, and using the solution for staining, immersion of the stained horn in 5% hydrochloric acid produces an iridescent surface, even on black buffalo horn. For graining, a 4% solution of Wool Blue in alcohol is used.—F. W. A.

Velocity of formation and solution, and the swelling of jellies. Traube and Köhler. See XXIV.

PATENTS.

Tanning; Process of tanning and — L. E. Levi, Assignor to Pfister and Vogel Leather Co., Milwaukee, Wis. U.S. Pat. 1,135,977, April 13, 1915. Date of appl., Dec. 29, 1913.

HIDES are tanned by immersion in a solution of non-acid ferric chromate or of a non-acid substituted ferric chromate.—F. C. T.

Casein binding materials; Manufacture of — L. Petersen-Hviid, Copenhagen. Eng. Pat. 1016, Jan. 14, 1914. Under Int. Conv., Jan. 14, 1913.

FRESHLY precipitated curd is mixed with infusorial earth and dried. The mass obtained is easily pulverised to a very fine powder, which possesses a very high binding capacity.—F. C. T.

Albumen compound; Indurated — B. B. Goldsmith, New York. U.S. Pat. 1,134,527, April 6, 1915. Date of appl., March 2, 1912.

A THERMOPLASTIC compound is prepared by submitting egg- and blood-albumin to the combined action of a normally solid converting agent, e.g., *β*-naphthol, and an indurating agent, e.g. formaldehyde, and heating and pressing the mixture. —J. F. B.

XVI.—SOILS; FERTILISERS.

Soil; Atmosphere of the — E. J. Russell and A. Appleyard. J. Agric. Sci., 1915, 7, 1—45.

THE free air in a soil, to a depth of 6 inches, occupies from 10–20% of its total volume, and has essentially the same composition as that of ordinary air, but it contains more carbon dioxide (0.25 against 0.03 vol. %), and less oxygen (20.6 against 20.9), and undergoes more fluctuations. The sum of the carbon dioxide and oxygen is only slightly less than in ordinary air, but falls below it when, owing to active nitrification or waterlogging of the soil, the oxygen content is depressed. The changes in composition are mainly due to biochemical activity, which is at a maximum in late spring and autumn, and at a minimum in summer and winter. In autumn, the bacteria increase first, then the carbon dioxide, and finally the amount of nitrate. Soil temperature is the chief factor from November to May; rainfall, and to a lesser extent soil moisture, from May to November. The dissolved oxygen in rainwater probably plays an important part in facilitating biochemical change. Grass land usually contains more carbon dioxide and less oxygen than arable soil. The effect of a growing crop is probably very small, but very difficult to determine owing to the difference in physical condition of cropped and fallow soils. The soil air is very still and usually nearly saturated with moisture; barometric changes, wind velocity, etc. have practically no effect upon it. At 18 inches below the surface there is more carbon dioxide than at 6 inches. Besides the free air there is another atmosphere dissolved in the water and colloids of the soil: it consists chiefly of carbon dioxide and nitrogen, oxygen being almost entirely absent. Anaerobic life in the soil is thus possible. —E. H. T.

Soil; Protozoa of the — A. Cunningham. J. Agric. Sci., 1915, 7, 49–74. (See Goodey, this J., 1915, 439.)

PROTOZOA cultures were made in soil extracts containing dipotassium phosphate, with and without the addition of protozoa-free cultures containing bacteria. The incubation period was 5 days at 22° C. Soils and cultures were obtained free from active protozoa by heating to 58° C., but at this temperature many encysted forms were also

destroyed. Flagellates were the most abundant in the soil extracts, followed by amoebae, and ciliates were found only in small numbers. At 2°C. all three forms were present, but below 8° only flagellates, and at 30° practically only ciliates were observed. The number of protozoa diminished in moist soil that was exposed to evaporation, but increased in saturated and 70%-saturated soils; the bacterial content decreased to a greater extent in the latter cases than in the former. It is inferred that some protozoa lead an active life in the soil and multiply when the conditions are favourable. By inoculating nutrient solutions with bacteria alone, and with protozoa and bacteria together, the limiting effect of the protozoa on the number of bacteria was established. Of three similar experiments to ascertain their influence on ammonification, only one indicated inhibition. The reduction in the number of bacteria in soils, partially sterilised with formalin and inoculated with protozoa cultures, was very marked.—E. H. T.

Protozoa: Examination of soil.—C. H. Martin and K. R. Lewin. *J. Agric. Sci.*, 1915, 7, 106—119.

The fauna found in the cultures from a soil do not necessarily correspond with the fauna present in the soil itself. Active (trophic) organisms in the culture may exist as cysts in the soil, and the amoebae develop very slowly, if at all, in cultures on ordinary media. It is probable that trophic protozoa exist in soils, even in such as are relatively dry and poor. The application of farmyard manure introduces a large number of protozoa into the soil, and if the manurial and water contents of the latter be high, these may develop to such an extent that soil sickness results. The nature of the protozoa apparently differs with the soil, but this difference could largely be explained by assuming that the fauna develops in cycles, in the order: small flagellates, larger flagellates and amoebae, ciliates; such cycles have been observed in culture media. The dominant active soil fauna are amoebae, thecamoebae, and small flagellates. Further research is required to determine why large flagellates are frequently found in soil cultures, whereas in fresh films the only flagellates found are very small monads. Soil protozoa should be studied from three points of view: active fauna, encysted fauna, "cultural" fauna.—E. H. T.

Soils: Lime requirement of — H. B. Hutchinson and K. MacLennan. *J. Agric. Sci.*, 1915, 7, 75—105. (See also this J., 1914, 932, 1065.)

The amount of lime necessary to produce the partial sterilisation effect in a soil, is determined by finding the quantity that will produce an alkaline reaction of the soil water. 100-grm. lots of the air-dried soil are treated in 250 c.c. bottles with calcium oxide in amounts rising by 0.2 gm. up to 2%, of the weight of soil. After adding 50 c.c. of water, the corked bottles are shaken for a few seconds at intervals for 4 hours or more, and the contents are then transferred to, and washed on, a Buchner funnel with 200 c.c. more water. The whole filtrate is then titrated with N/10 acid in presence of phenolphthalein. If a given filtrate does not need more than 5—10 c.c. of this acid, the amount of lime used may be taken as the optimum. By this method the amounts of lime required by different soils agree with those that produce typical partial sterilisation effects, e.g. inhibition of protozoa. These results, and those obtained with pot experiments, show that when the critical amount of lime is added, a maximum production of dry matter is obtained, not only in the first crop, but in the first four crops. Heavier applications of lime augment the ammonia and nitrate production, but do not give a corresponding increase of crop. The addition of the critical amount of

lime to a soil appears to induce a maximum flocculating effect upon it. The authors' method of determining the lime required to effect neutralisation of a soil (this J., 1914, 932) is superior to many others as it does not indicate lime-requirement in the case of neutral soils, and the lime requirement of a soil is more important than its content of free carbonate. Comparative tests of various lime-treated soils showed proportionate diminution of the lime requirements, and lime added as carbonate has produced increased ammonia and nitrate in laboratory experiments, and greater plant growth in field tests. The effects of lime on field soils may extend to upwards of 17 years. For neutralisation, calcium oxide and calcium carbonate are equally effective. On acid (Woburn) soil, the crop yields were proportional to the reduction in acidity. Ammonification, and to a lesser extent, nitrification, are accelerated by the application of carbonate. The natural flora of soils on the same geological formation bears a definite relation to their lime requirements.—E. H. T.

Soil: Influence of the character of the — on bacteria and the changes in the soil. H. R. Christensen. *Centr. Bakl. Par.*, 1915, ii., 43, 1—106. *J. Chem. Soc.*, 1915, 108, i., 196.

The results of inoculation experiments with a large number of soils showed that *Azotobacter* occurs very frequently in soils which contain sufficient calcium carbonate to effervesce when treated with hydrochloric acid; neutral soils seldom contain *Azotobacter*, whilst in acid soils it very rarely occurs. It is considered probable that a vigorous growth of *Azotobacter* when a soil is added to a mannitol solution free from phosphates, is a certain indication that the soil is not deficient in phosphoric acid. Microbes which ferment mannitol occur in practically all arable soils, in numbers which seem to depend mainly on the amount of calcium, in a suitable form, in the soil. Great variations occur in the power of different arable soils to decompose peptone, depending partly on the composition (phosphoric acid being especially important), and partly on biological conditions. Addition of calcium carbonate was generally without effect, and none of the soils was influenced by addition of humus. A low power of decomposing peptone indicates unfavourable conditions for the growth of plants. The rate of decomposition of cellulose in soils seems to depend on chemical conditions, since inoculation was without effect. Basic calcium and phosphoric acid are the chief factors. It was previously shown that peat of the "Hochmoor" variety usually fails to produce nitrites in the solutions employed. This is shown to be due to the absence of nitrite organisms, and not to the presence of inhibiting substances.

Soil constituents: Effect of some organic — on nitrogen fixation. H. S. Reed and B. Williams. *Centr. Bakl. Par.*, 1915, ii., 43, 166—176. *J. Chem. Soc.*, 1915, 108, i., 196.

In a study of the fixation of nitrogen by *Azotobacter* on sand with mineral nutrients and various non-nitrogenous organic compounds, it was found that with the exception of asculin, quinic acid, and borneol, which increased the activity of *Azotobacter*, all the compounds employed caused a depression. Quinol and salicylaldehyde completely inhibited nitrogen fixation; most of the other compounds were, however, much less injurious than would be expected from their action on higher plants. Many of the nitrogenous compounds employed, which have been found to be assimilated by higher plants, had a depressing effect on fixation, the simpler compounds having a more marked depressing effect than the more complex compounds.

It is considered possible that the simpler compounds (urea, glycine, and formamide) are not toxic, but that their nitrogen is possibly utilised by *Azotobacter* in preference to elementary nitrogen.

Iron disulphide (pyrite) in soils; Determination of —. V. Rodt. Mitt. Materialprüfungsamt, 1914, 32, 431—432. Z. angew. Chem., 1915, 28, Ref. 77.

IRON disulphide has a destructive action on concrete. For its determination the soil is lixiviated with warm hydrochloric acid (1:3) to remove ferrous sulphide and sulphates, then dried *in vacuo* over sulphuric acid, extracted with carbon bisulphide in a Soxhlet apparatus to remove sulphur, again dried *in vacuo*, and then heated on the water-bath with nitric acid (1:3) to which bromine water has been added. Iron is determined in one portion of the resulting solution, and sulphuric acid in another, after evaporating to expel nitric acid and bromine, and dissolving the residue in hydrochloric acid. Sulphur in organic combination is not oxidised by the treatment described. Ferrous sulphide cannot be determined by means of the hydrogen sulphide evolved on treatment with hydrochloric acid, if stannous chloride be added to prevent oxidation, because in presence of this compound iron disulphide is attacked by hydrochloric acid.—A. S.

Sulphur and sulphur compounds in soils; Changes of —. H. Kappen and E. Quensell. Landw. Versuchs-Stat., 1915, 86, 1—34. J. Chem. Soc., 1915, 108, i, 203.

WHEN moist soil is treated with hydrogen sulphide, the soil is blackened, owing to the production of iron sulphide, and a portion of the sulphide decomposes with liberation of free sulphur. The iron sulphide then undergoes a process of oxidation, in which all of the sulphur is liberated, so that the whole of the hydrogen sulphide absorbed is converted into free sulphur. The sulphur is then oxidised to sulphuric acid, the change being more rapid in normal than in sterilised soils. It is, however, doubtful whether the slower oxidation of sulphur in sterilised soils is due to the absence of microbes, or to other changes in the soil due to the sterilising process. Sulphides and sulphites are decomposed more quickly in presence of soil than without soil. In soils the decomposition is so rapid that no injurious effects on germination and growth are to be expected.

Calcium cyanamide; Manurial experiments with decomposition products of —. H. Kappen. Landw. Versuchs-Stat., 1915, 86, 115—136. J. Chem. Soc., 1915, 108, i, 203—204.

EXPERIMENTS were made in small garden plots on the growth of mustard manured with different forms of nitrogen. The yield with urea, prepared from calcium cyanamide, was between those obtained with sodium nitrate and ammonium sulphate, whilst urea nitrate gave much lower results; guanidine nitrate gave the smallest yields. The relatively low results obtained with urea nitrate were found to be due to the presence of a considerable amount of dicyanodiamidine, produced from diacyanodiamide. The results of an experiment in which dicyanodiamidine was added to soil showed that very little ammonia was formed in three days, and no further increase was found in ten days.

Plants; Action of certain compounds of zinc, arsenic, and boron on the growth of —. W. E. Brechley. Annals of Botany, 1914, 28, 283—301.

ZINC sulphate in high concentration is very toxic to barley and peas, and no evidence of stimulation has been obtained with any strength of the poison down to a lower limit of 1/200,000,000. Arsenious

acid is more toxic in its action on peas and barley than is arsenic acid, peas being particularly susceptible. This distinction holds good for sodium arsenate and sodium arsenite, though in a less degree. Again no stimulation is evident with the smallest quantities so far tested. Boric acid is less poisonous than zinc sulphate or arsenic compounds, especially with peas. To the eye barley shows stimulation with some of the weaker strengths of poison, but this is not borne out by the dry weights. Peas, on the other hand, are definitely stimulated with relatively high concentrations of boric acid. The action of the greater strengths of the poison is well marked in the leaves, which tend to become brown, and to die, in a characteristic manner.

Maize; Chemical poisoning and variation in —. A. Jungelson. Comptes rend., 1915, 160, 481—483.

MAIZE seeds which had been in contact for from 1 to 24 hours with dilute aqueous solutions of copper sulphate, before being sown, produced in many cases abnormal spikes. The percentage of abnormal plants was greater with grains which had been deprived of their seed coat or otherwise mutilated before treatment with the copper salt, than with those which were left intact, although the mutilation alone produced in no single case an abnormal inflorescence. The poisoning of the seed thus induced a special tendency of the plant to assume new forms, this tendency being greater the more intimate the contact between the seed and the toxic agent. This may be an important factor in the evolution of vegetable species.—G. F. M.

Bordenur mixtures. Fonze-Diacon. See XIX.

PATENTS.

Manures and fertilisers; Artificial —. T. Twynam, Redcar. Eng. Pats. 5181 and 9124, Feb. 28 and Apr. 11, 1914.

FINELY ground basic slag is treated with a limited proportion of diluted nitric acid, preferably with that of about 33% strength as obtained direct from an atmospheric nitrogen fixation process. The phosphoric acid content is thereby converted into a more readily available form; the iron compounds remain undissolved, and there is no appreciable formation of gelatinous silica. A complete non-hygroscopic plant food is produced by mixing the product with ammonium or potassium sulphate.—E. H. T.

Fertiliser, and process of producing same. C. A. Black, Cleveland, and W. H. Teare, Lakewood. Assignors to J. R. Cowell, Toledo, Ohio. U.S. Pat. 1,124,324, Dec. 15, 1914. Date of appl. March 9, 1914.

LOGGERHEAD sponge, a product found in the sea in certain semi-tropical regions, is cut up, dried to a definite moisture content (6% or less), and granulated. When the drying cannot be done soon after its removal from the sea, the sponge is treated with an antiseptic, e.g., sulphur dioxide, to prevent putrefaction.—E. H. T.

Fertiliser; Process of manufacturing artificial —. H. Herzfeld and O. Hauser, Berlin. U.S. Pat. 1,125,318, Jan. 19, 1915. Date of appl. Sept. 11, 1913.

FOUR parts of a potassium mineral, e.g. phosphenite, is heated for 5—15 hours at about 300°C. with one part of the mother liquor left after potassium chloride has been separated from carnallite. The natural silicate is converted into a solid paste, which gradually gives up its fertilising constituents to the soil solution.—E. H. T.

Fertiliser; Converting meadow or swamp land into — B. Reichelt, Newark, N.J. U.S. Pat. 1,134,760, April 6, 1915. Date of appl., May 2, 1913.

THE material is heated in a furnace out of contact with the flames to drive off the potash, which is collected. The residue is ground, and then mixed with the potash.—B. N.

Nitrogen and potash; Concentrated product of — and process of recovering and solidifying the same. [Fertiliser from molasses.] S. W. Sinsheimer, Swink, Colo. U.S. Pat. 1,134,921, April 6, 1915. Date of appl., May 10, 1913. Renewed Jan. 23, 1915.

THE raw waste liquor obtained in the separation of sugar from molasses, is heated to about 100° C. to precipitate sucrose of lime, and filtered. The filtrate is treated with hot furnace gases containing carbon dioxide, the precipitated carbonates are filtered off, the filtrate is concentrated by the combined action of a low temperature and a vacuum, and the residue dried at a low temperature.—B. N.

Nitrate fertiliser and process of making the same. A. Messerschmitt, Stolberg, Germany. U.S. Pat. 1,135,387, April 13, 1915. Date of appl., Oct. 5, 1912.

SEE Ger. Pat. 255,910 of 1911; this J., 1913, 439.

XVII.—SUGARS; STARCHES; GUMS.

Gentiobiose. G. Zemplén, Ber., 1915, 43, 233—238. J. Chem. Soc., 1915, 108, i., 119—120.

THE biochemical synthesis of gentiobiose by the action of emulsin on dextrose, which was achieved by Bourquelot, Hérissey, and Coirre (this J., 1913, 1080) does not accord with E. F. Armstrong's statement ("The Simple Carbohydrates and the Glucosides," 1912, p. 97) that maltose may be obtained in this way. The formation of an α -disaccharide, like maltose, is also contrary to the established rule that enzymes only bring about the synthesis of those disaccharides which, under other conditions, are hydrolysed in their presence. In the case of emulsin these would be β -disaccharides like gentiobiose, cellobiose, or *iso*-maltose. The author repeated Bourquelot's work with positive results, for he isolated the octa-acetate and phenyllosazone of gentiobiose from the product of the action of emulsin on a 50% dextrose solution. With the idea of deciding whether gentiobiose is identical with *iso*-maltose or not, syrups containing the latter were prepared by Fischer's method (this J., 1891, 377) and acetylated. Although the octa-acetate of gentiobiose is readily isolated from very impure products, it could not be obtained from these syrups and it seems to be highly probable, therefore, that gentiobiose and *iso*-maltose are not identical.

Cause and significance of an abnormal reaction obtained in testing urine for sugar with Fehling's solution. Cramer. See XVII.

New test for reducing sugars in urine. Cramer. See XVII.

PATENTS.

Sacchariferous vegetable slices; Apparatus for leaching — M. Paschen, Cöthen, Germany. U.S. Pat. 1,134,152, April 6, 1915. Date of appl., Sept. 18, 1913.

THE apparatus consists of a trough divided into a number of leaching chambers by transverse walls, perforated in their lower portions and arranged in

pairs so as to form a number of separating chambers alternating with the leaching chambers. Over each pair of walls an inclined roof, extending from one wall to the other, incloses each separating chamber, and an intermediate partition terminating short of the roof is situated between the walls. —J. F. B.

Starch, etc.; Process for treating — F. P. Bergh and H. C. Neuberg, Assignors to General Reduction Co., New York. U.S. Pat. 1,133,914, March 30, 1915. Date of appl., April 28, 1911.

STARCH with a moisture-content about equal to that of green starch is partially gelatinised by dropping it through a chamber in which it meets hot gases laden with moisture. It may afterwards be dried and disintegrated.—J. H. L.

Carburising iron or steel. [Utilising fibrous waste from sugar manufacture.] U.S. Pat. 1,133,626. See X.

Concentrated product of nitrogen and potash, and process of recovering and solidifying the same. [Fertiliser from molasses.] U.S. Pat. 1,134,921. See XVI.

XVIII.—FERMENTATION INDUSTRIES.

Hops; Investigations on — VI. Amount of lupulin in plants raised by crossing. J. Schmidt. VII. Employment of artificial light in the titration of the resins in hops. S. H. Larsen. Comptes rend. Trav. Lab. Carlsberg. 1915, 11, 165—187. (See also this J., 1915, 43, 440.)

VI. MORE than twenty-hop plants of various types, from Germany, Austria, England, and Denmark, were crossed with wild Danish male hops in 1911, the seeds were sown in the spring of 1912, and the seedlings, numbering 744, investigated in the season 1913. The resin-content (lupulin-content) was determined by the method previously described (this J., 1915, 43); the average value for the mother plants, exclusive of Danish, was 14.1%, and that for the Danish plants was 8.9%. The resin-content of individual seedlings from the same mother plant often varied over a range of 8% or more, but the mean value for each group of sister-seedlings was lower than that for the mother plant by about 4% on the average, except in the case of Danish hops where no marked decrease was produced by crossing. Seedlings of higher resin content would probably have been obtained if male plants of cultivated hops had been used for fertilising. In most cases, however, individual seedlings of considerably higher resin-content than the mother plant were obtained, and they were in general the more numerous the lower the resin-content of the parent-plant. The selection and vegetative propagation of the best of these seedlings, would in a few years yield a large number of clone-plants (see this J., 1915, 440) of high lupulin-content available for the planting of large gardens.

VII. In carrying out the titration of the resins (see this J., 1915, 43) by artificial light, the author stands the flask on a ground glass plate which forms the cover of a wooden box containing a metal-filament lamp. The results are practically identical with those obtained in daylight.—J. H. L.

Enzymes; Production of — and its cause. H. Zikes. Monatsh. Landw., 1914, 7, 24. Bied. Zentr., 1915, 44, 68—69. J. Chem. Soc. 1915, 108, i., 197.

Yeast which had been cultivated for fourteen years in dextrose solutions at once fermented sucrose when transferred to sucrose solutions. Similar

results were obtained with maltose solutions. The yeast still contained, therefore, both invertase and maltase in the form of a zymogen.

Phytochemical reductions. V. Intermediary stages in the reduction of nitro-groups to amino-groups. C. Neuberg and E. Welde. *Biochem. Zeits.*, 1914, **67**, 18—23. *J. Chem. Soc.*, 1915, **103**, i., 197. (See also this J., 1914, 434, 608.)

It has been shown already that nitrobenzene is reduced to aniline when added to a sugar-fermentation mixture. When azoxybenzene or azobenzene was added to a fermentation mixture, little if any aniline was formed. On the other hand, from 21 grms. of nitrosobenzene 4.0 grms. of aniline was obtained, and from the same quantity of phenylhydroxylamine, 7.5 grms. In both cases azobenzene was also formed. The results appear to indicate that the intermediate products in the reduction of nitrobenzene to aniline are nitrosobenzene and phenylhydroxylamine. The bearing of these results on the reduction of nitrates by plants is discussed.

Phytochemical reductions. VI. Formation of n-heptyl alcohol by yeast. C. Neuberg and F. F. Nord. *Biochem. Zeits.*, 1914, **67**, 24—27. *J. Chem. Soc.*, 1915, **103**, i., 197.

WHEREAS aldehydes containing three, four, or five carbon atoms are readily reduced to the corresponding alcohols when added to a yeast fermentation mixture, a considerable resistance is offered to reduction by the 7-carbon atom aldehyde, heptaldehyde. It is now shown that the 6-carbon atom aldehyde, n-hexaldehyde, occupies an intermediate position, being reduced with greater difficulty than the lower aldehydes, but offering less resistance than the higher one. The addition of the aldehyde stops fermentation after a period, before the sugar is all destroyed, but the addition of fresh yeast causes the fermentation to start again.

Amylase of potatoes; Changes produced by pathological conditions in the —. G. Doby and J. Bodnar. *Biochem. Zeits.*, 1915, **68**, 191—205. *J. Chem. Soc.*, 1915, **103**, i., 202.

THE changes in the concentration of the amylase in potatoes were investigated after varying intervals in the freshly expressed juice, and in juices kept under antiseptic conditions. The results indicated that the ferment exists both in the form of enzyme and zymogen, the former being somewhat sensitive and rapidly destroyed. As long as the tubers contain excess of zymogen, amylase is set free more rapidly from the zymogen than it is destroyed. For a time, therefore, the amylolytic activity of the juice increases. Towards spring, however, the amount of zymogen commences to diminish to such an extent that the amount of amylase destroyed becomes greater than that set free, and the amylolytic activity of the juice diminishes. The amylolytic activity of the juice kept under antiseptic conditions rapidly diminishes. Healthy plants in general yield juices of greater amylolytic activity than those infected with the curly leaf disease.

Chemical poisoning and variation in maize. Jungelson. See XVI.

Individuality of oxidising and reducing enzymes. Bach. See XXIV.

PATENTS.

Saccharification and fermentation of amylaceous substances. A. Molhant, Mons, Belgium. U.S. Pat. 1,134,281, April 6, 1915. Date of appl., July 17, 1914.

SEE Fr. Pat. 471,775 of 1913; this J., 1915, 444.

Alcoholic liquids; Continuous process for the distillation and rectification of —. V. Slavicek, Vienna. U.S. Pat. 1,136,559, April 20, 1915. Date of appl., Oct. 29, 1908.

SEE Fr. Pat. 394,949 of 1908; this J., 1909, 377.

XIXa.—FOODS.

Milk; Determination of total solids and nitrogen in —. G. Meillère. *J. Pharm. Chim.*, 1915, **11**, 167—170.

A WHITE residue of constant weight is obtained by evaporating 5 to 10 c.c. of the milk in a cylindrical dish (7 cm. in diameter by 2.5 mm. in height) for 3 to 4 days in a bacteriological oven at 37° C. The result agrees with that obtained by evaporating the milk for six days at the ordinary temperature or for 48 hours at 37° C. *in vacuo*. The treatment with sulphuric acid in Kjeldahl's process is considerably shortened by using the residue from 10 to 20 c.c. of the milk instead of the milk itself.—C. A. M.

Chicory. V. Grafe. *Biochem. Zeits.*, 1915, **68**, 1—22. *J. Chem. Soc.*, 1915, **103**, i., 200.

THE inulin-content of the roots depends on the water-content of the soil on which the plant is grown, being low when the plant is grown on wet soils. The ash-content varies between 5 and 8%, but the amount of "crude fibre" diminishes in plants from sand and loams, and increases on humus-rich soils. The amounts of inulin and bitter principles obtained from plants grown on loams and sands is also generally larger than those of plants from humus-rich soils. The bitter principle has not been obtained in a pure condition; it appears to be a glucoside of levulose and a protocatechuic derivative, probably the aldehyde, the former of which is derived from inulin, and the latter from the dextrin-like degradation products of the same. The empyreumatic oil obtained by roasting is analogous to coffee oil, and the chief constituent is acetic acid; it also contains valeric acid, acetaldehyde, and furfuryl alcohol (23—25%).

Chicory and its substitutes. E. Collin. *Ann. Pâiss.*, 1915, **8**, 63—79.

THE supply of chicory, which has been mainly drawn from Belgium and north-eastern France, is now greatly reduced, and the risk of adulteration is consequently greater than usual. The author describes, with the aid of diagrams, the microscopic features of roasted chicory and materials likely to be used as adulterants, *e.g.*, beetroots, carrots, Jerusalem artichokes, barley, wheat, figs, carob beans, peas, beans, vetches, lupins, soya beans, acorns, date stones, grape stones, toasted bread, and peat. Commercial chicory, whether in the powdered or granular form, should be decolorised before microscopic examination, by steeping in a solution of sodium hypochlorite; the time required for decolorisation depends on the degree of torrefaction of the individual particles. In the granular form of chicory, the particles vary from 1 to 4 mm. in size; under a simple lens they appear quite irregular in shape, with a dull, irregular surface sometimes finely striated. Under the microscope the features which distinguish chicory from most of the other materials mentioned are the presence in the woody tissue of dark reticulated laticiferous ducts containing a finely granular matter which the treatment with hypochlorite renders distinctly visible, and the complete absence of crystals, starch, or cells with thick channelled walls.—J. H. L.

Saccharin; Detection and determination of — in foodstuffs. Ceccherelli. Riv. di Igiene et Sanita Pubblica, 25, 446, 464. Ann. Falsif., 1915, 3, 109—110.

In the determination of saccharin, the treatment of the ether extract with potassium permanganate (cp. Testoni, this J., 1910, 106; Posseti and Issoglio, 1912, 297; Condelli, 1914, 983) is not to be recommended, though it is useful in making qualitative tests. Gum tragacanth, extract of gentian, and certain other substances, after fusion with sodium hydroxide produce colorations with ferric chloride and may therefore interfere with this method of testing for saccharin. The following test, based on the liberation of the amino-group, is described by Tarugi and Leni (Rend. Soc. Chim. Ital., 1911, 7, 320):—A minute quantity of saccharin, heated with a few drops of sulphuric acid until white fumes appear, then cooled, diluted with water, neutralised with soda, and added to a solution of a crystal of phenol in sodium hydroxide, gives a blue colour on addition, drop by drop, of a fresh solution of sodium hypochlorite. The author concludes that there is at present no satisfactory means of determining saccharin, applicable to all cases, but the presence of this substance may be regarded as certain if the ether extract, after treatment with permanganate, yields a residue which glistens slightly, contains sulphur, yields an insoluble silver salt containing 37% Ag, gives the reactions of salicylic acid after fusion with soda but not before, and also gives the Tarugi-Leni reaction after hydrolysis.—J. H. I.

Sodium pyrophosphate administered with food; Toxicity of —. Toxic cotton-seed meal. W. L. Symes and J. A. Gardner. Biochem. J., 1915, 8, 9—16.

SODIUM pyrophosphate administered, with food, to rabbits, cats, and rats, is devoid of the toxic action that it shows when injected intravenously. Administered to a sheep in the same way, however, it proved fatal, the sheep dying after having received a daily dose of 1 gm. of $\text{Na}_2\text{P}_2\text{O}_7 \cdot 10\text{H}_2\text{O}$ for 21 days. The introduction of the salt into the already alkaline contents of the rumen increased the alkalinity of the latter to such an extent as to produce marked softening of the mucous membrane of the organ, inflammation, etc. In the case of rabbits, cats, and rats, probably the salt was neutralised as soon as it reached the stomach.—W. P. S.

Crude fibre; Determination of —. R. Fanto and W. Nikolitsch. Z. anal. Chem., 1915, 54, 73—76. J. Chem. Soc., 1915, 108, ii, 186.

THE filtration of the acid and alkaline solutions in the estimation of crude fibre may be rendered more rapid by the use of a filter-thimble of such capacity that it will hold the whole of the solution. The acid or alkaline digestion mixture is poured into the thimble, and when the liquid portion has passed through, the thimble is suspended in water; the latter passes inwards through the walls of the thimble, which is then raised, and the washing of its contents is continued in this way. This procedure prevents the fine particles of substance from clogging the walls of the thimble. When washed, the crude fibre is rinsed into a platinum basin, dried, and weighed.

Changes produced by pathological conditions in the amylase of potatoes. Dohy and Bodnar. See XVIII.

PATENTS.

Cocoa powder; Treating cocoa for making —. W. J. Mellersh-Jackson, London. From Massachusetts Chocolate Co., Boston, Mass., U.S.A. Eng. Pat. 14,456, June 16, 1914.

CAKE cocoa is treated in a breaking up machine

at 120°—135° F. (40°—57° C.) for 20—30 min. until a sufficiently deep colour is obtained. The powder is sucked up into a pipe by a fan and passes through the fan into a hopper; the excess of air passes to a reserve hopper, and the fine cocoa passes from the bottom of the hopper by a pipe leading into another room or compartment and is delivered into an open hopper. From here the powder, which now consists of fine separate particles, is drawn by a fan, together with the air of the room, which is kept at 40°—45° F. (4°—7° C.) into a pipe leading to another hopper where the separation is repeated. A further separation in another hopper follows. In each hopper the air current with the powder enters at the periphery, so that a cyclonic action is produced inside and the powder subjected to great attrition. The cocoa powder obtained from the last hopper is ready to be sifted, and is 90% fine.—J. H. J.

Baking preparation. E. G. L. Kressel, Camden, N.J., Assignor to Wilkes, Martin, Wilkes Co., New York. U.S. Pat. 1,134,956, April 6, 1915. Date of appl., Jan. 15, 1914.

A MIXTURE of an acid mellitate, such as dicalcium mellitate, an alkali carbonate or bicarbonate, and a filler.—J. H. J.

XIXb.—WATER PURIFICATION; SANITATION.

Drinking water; Purification of — by means of calcium hypochlorite. H. Vincent and Gaillard. Comptes rend., 1915, 160, 483—486.

CALCIUM hypochlorite possesses undoubted practical advantages over solutions of alkali hypochlorites for sterilising water. It is conveniently used in the form of compressed tablets, each containing 0.015 gm. of calcium hypochlorite (= 3.5 mgrms. available chlorine) and 0.08 gm. of sodium chloride, the latter being added to promote the diffusion of the active chlorine into the water. Each tablet is sufficient for 1 litre and is added to the water without previous crushing. After 20 mins. practically the whole of the chlorine has diffused into the water and merely a skeleton of calcium carbonate remains. The tablets keep quite well, a diminution of only 0.0003 gm. of active chlorine being observed within 2 months. Drinking water sterilised in this way can be consumed 20 mins. after the addition of the tablet. Its mineral composition is thereby scarcely altered, and its taste is inappreciable. Ammoniacal and albuminoid nitrogen were found to diminish by one-half to three-quarters after the sterilisation with a hypochlorite tablet, whilst all pathogenic organisms, including *Bacillus coli*, were killed in 10—12 mins., even in the presence of much organic nitrogen.—G. F. M.

Iron in water; Determination of — with titanium trichloride. J. Zink and R. Liere. J. Gasbeleudt., 1914, 57, 956. Z. angew. Chem., 1915, 28, Ref., 77.

KNECHT and Hibbert's method of titrating ferric iron with titanium trichloride (this J., 1903, 232, 825; 1907, 1163) gives good results when applied to the determination of iron in water. The water is boiled with nitric acid, treated with ammonia, the precipitated iron and alumina dissolved from the filter in hydrochloric acid, and the solution titrated with titanium trichloride. It is not necessary to pass carbon dioxide through the solution whilst titrating. With a number of waters containing from 0.1 to 30 mgrms. Fe per litre, and also some manganese, the results agreed within ± 0.2 mgrm. Fe per litre with those obtained by the colorimetric method in 50% of the determinations.—A. S.

Organic matter in potable water; Determination of — J. D. Filippo and H. J. Baeker. Chem. Weekblad, 1915, 12, 73—78, 150—156. J. Chem. Soc., 1915, 108, ii., 109, 183—184.

CARBOHYDRATES and other organic matter present in water are oxidised to oxalic acid by permanganate in alkaline solution. To avoid the error thus introduced, the solution should be acidified before determining the excess of permanganate by titration by the iodometric method. The permanganate value is unaffected by the presence of either ferric salts or nitrates, or by appreciable quantities of ammonium salts in acid solution. In alkaline solution, ammonium salts exert a slight influence. For water containing a moderate proportion of organic matter and more than 500 mgrms. of chlorine per litre, the oxidation should be carried out in alkaline solution. If the proportion of organic material is very small, this limit should be reduced to 250 mgrms. No correction is necessary with a sulphur content of 0.05 mgrm. per litre. In presence of nitrites, each mgrm. of NO_2 per litre necessitates the subtraction of 1.374 from the permanganate value, but no correction is necessary if the NO_2 content does not exceed 0.1 mgrm. per litre. In presence of ferrous salts and only a trace of nitrite, the oxidation should be carried out in acid solution, and corrected by deducting the amount of permanganate reduced in the cold by the acidified water. When the nitrite content is high, the ferrous salts should be oxidised by agitation with air, and a correction for nitrite applied as indicated above. Equally accurate results are obtained by the alkaline and acid oxidation, the oxalic acid titration, and the iodometric method. When proteins are present, the acid method is the best.

Bordeaux mixtures. Fonze-Diacon. Comptes rend., 1915, 160, 528—530.

It has been shown that acid Bordeaux mixtures are richer in the tetra-copper basic sulphate; they yield in solution free copper sulphate, in addition to the basic salt, and their anti-bacterial action is high. The more nearly neutral the mixtures are, the less they yield of this basic compound; the alkaline mixtures yield very little. The latter in solution give copper bicarbonate, which, by rapid decomposition with air, gives only copper hydrocarbonate, a form in which the copper is less active.—B. N.

Determination of formaldehyde and methyl alcohol in aqueous solutions. Lockemann and Croner. See XX.

Determination of carbon monoxide by the iodine pentoxide method. Froboese. See XXIII.

PATENTS.

Sewage; Apparatus for the treatment of — T. Craney, Bay City, Mich. U.S. Pat. 1,134,107, April 6, 1915. Date of appl., Feb. 24, 1914.

THE treatment is carried out in a vat divided into compartments by submerged walls. In each compartment a pair of electrodes hangs down from the water level and extends across the vat. A filter screen is supported in an inclined position between the electrodes and the submerged wall on the exit side of each compartment. The sewage passes down one side and under the electrodes, up through the screen and over the submerged wall into the next compartment. The vat may have either a flat or a hopper-shaped bottom, and may have a conveyor along the bottom to remove the separated solids and a conduit at the water level to remove floating solids.—J. H. J.

Sewage; Purifying — and recovering organic matter therefrom. G. W. Miles, Belmont, Mass. U.S. Pat. 1,134,280, April 6, 1915. Date of appl., Feb. 16, 1914.

SULPHUR dioxide is passed into the sewage before decomposition has progressed materially, the resulting sulphurous acid causing the precipitation of organic matter which is ordinarily non-precipitable. The precipitate is allowed to settle and the clarified liquid separated.—J. H. J.

Garbage; Process of incinerating — and apparatus therefor. W. M. Carr, Wheeling, W. Va. U.S. Pat. 1,131,512, April 6, 1915. Date of appl., Dec. 11, 1911.

THE garbage is dried and distilled in a closed vessel, and the carbonised residue is gasified in a producer into which the steam and gas evolved during the drying and distillation of the garbage are also passed. The producer gas is burned and used to dry and distil fresh garbage.—J. H. J.

Petroleum; Process of rendering — soluble, and product resulting therefrom. C. Parigot. Fr. Pat. 472,873, Aug. 23, 1913.

PETROLEUM products or saturated hydrocarbons are heated in an autoclave with sulphuric or nitric acid in the presence of a solvent (e.g. methyl, ethyl, or amyl alcohol), and then with an organic acid compound (e.g. shellac, rosin), and the mixture is neutralised with alkali. The resulting products are soluble in water, have general disinfectant properties, and can be used as insecticides in agriculture.—C. A. M.

Sewage; Apparatus for drying the sludge or solid matter recovered from — A. B. Ogden, Manchester. U.S. Pat. 1,135,390, April 13, 1915. Date of appl., July 13, 1914.

See Eng. Pat. 6200 of 1914; this J., 1914, 1221.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Vegetable drugs and poisonous plants; Investigations of — Bull. Imp. Inst., 1915, 13, 28—65.

Hyoscyamus muticus from Egypt. A sample consisting largely of stems, $\frac{1}{2}$ in. to $\frac{1}{4}$ in. diam., together with small stems, broken leaves, and flowering heads, contained 8.3% H_2O and 0.58% of hyoscyamine. Egyptian *H. muticus* is a valuable source of hyoscyamine or atropine (see this J., 1899, 171; 1901, 66; 1903, 1013) and is of special importance at present owing to the failure of continental supplies of atropine. Arrangements have been made for supplying the plant from Egypt to British manufacturers.

Bark and fruits of Strychnos Henningsii, Gilb., from South Africa. The bark contained 4.8% the husks of the fruit 0.16%, and the kernels 4% of an alkaloid, different from strychnine and brucine, but which could not be obtained in a crystalline condition, except in one experiment in which a few rosettes of white needles were obtained, which decomposed between 260° and 270° C. The husks contained 4.9% of an orange-red fat, and the kernels 17.6% of a pale, brownish-orange oil.

Xanthoxylum brachycanthum bark from Queensland (see this J., 1913, 251).

Daphnandra micrantha bark from Australia (see this J., 1914, 705).

Peganum Harmala seeds from India. The seeds contain two alkaloids, harmaline and harmine (see this J., 1889, 412; 1897, 1036; 1905, 149; 1912, 659; 1914, 216). The physiological action of harmaline resembles very closely that of quinine

(see this J., 1909, 1324). Harmine has a similar action but is only about half as toxic as harmaline.

Podophyllum Emodi, Wall., from India. Indian podophyllum (*P. Emodi*, Wall.) contains more resin than the American *P. peltatum*, Linn. (see this J., 1896, 918; 1898, 268, 865), and the Indian rhizome has been incorporated in the B.P. 1914. Two samples of rhizomes from cultivated plants contained respectively 10.2 and 10.8% H_2O , 11.1 and 11.7% total resin (podophyllin), and 4.7 and 3.1% podophyllotoxin. A sample of rhizomes from wild plants contained 9.2% H_2O , 15% podophyllin, and about 2.5% podophyllotoxin.

Croton Eliottianus (Baill.) seeds from E. Africa. *Protectorate* (see also this J., 1908, 131). The kernels contained 57.4% of a dark yellow, almost tasteless oil, equivalent to about 34% in the entire seeds. The oil had the sp. gr. 0.927 at 15° C.; acid value, 3.6; saponif. value, 191.6; iodine value, 147; Hehner value, 94.8; solidif. pt. of fatty acids (titer test), about 14° C. The fatty acids consisted of 80% of linolic acid, 10% of oleic acid, and 10% of saturated acids, principally palmitic acid. Physiological investigation by J. T. Cash and W. J. Dilling (J. Pharmacol. and Exp. Therap., 1914, 6, 235) showed that the oil is valuable as a laxative or purgative, owing to its relatively non-irritant action and its high potency in relation to small bulk.

Oleo-resins. Four samples of oleo-resins used as substitutes for, and sometimes as adulterants of copalba balsam were examined, viz., *Hardwickia pinnata* balsam from India (see also this J., 1905, 689), oleo-resin or "wood-oil" of *Diplerocarpus erinitus* ("Kruing Sap") from Federated Malay States, somewhat similar to gurjun balsam, and oleo-resin of *Daniella thurifera* (*Paradaniella Oliveri*, Rolfe; see Kew Bull., 1912, 96) from the Gold Coast and from Nigeria (see also this J., 1908, 1129, 1162; 1914, 765).

Poisonous plants. Specimens of *Acokanthera venenata*, G. Don, from the Transvaal, and of "Cape Slangkop" (*Ornithoglossum glaucum*, Salisb.) from S. Africa were found to contain poisonous, bitter, amorphous substances with a physiological action similar to that of digitalis (see also this J., 1895, 985; 1902, 1468). The leaves of *Tephrosia Vogelii*, Hook., from Rhodesia were found to contain 0.15% and the seeds 0.3% of tephrosin (see this J., 1907, 714). The leaves also contained 0.06% of tephrosal and 0.05% of the yellow substance, m. pt. 228°—229° C., isolated by Hanriot (*loc. cit.*), whilst the seeds contained 0.008% of the yellow substance and 0.11% of a few, colourless non-nitrogenous substance, m. pt. 158° C.—A. S.

Aromatic distilled waters [cinnamon water and thyme water]. A. Goris and C. Vischniac. Bull. Sci. Pharmacolog., 1915, 65. Pharm. J., 1915, 94, 625.

CINNAMON water on extraction with ether yielded 0.145% of essential oil, of which 92% was cinnamic aldehyde; the remainder gave a reaction for eugenol. The oil remaining after the preparation of the cinnamon water contained 78% of the aldehyde, and also a certain amount of eugenol. The "water" prepared from thyme oil contained 0.657% of essential oil, of which 46% was phenolic, with carvacrol as the principal constituent; the residual thyme oil contained 32% of phenolic substances, consisting almost entirely of carvacrol.

Alkaloidal assays; A possible source of error in —. P. A. W. Self. Pharm. J., 1915, 94, 585—586.

In an alkaloidal assay, if the alkaloid is liberated by ammonia and the volatile solvent employed in the last shaking out is not washed with water, traces of ammonium salts may be carried into the evaporation vessel. On evaporation the alkaloid liberates ammonia in most cases, forming an

alkaloidal salt, hence the result is too high if the residue is weighed and too low if titrated, the error on titration being comparatively large owing to the high molecular weight of most alkaloids. Even 1 mgrm. of an ammonium salt may cause an appreciable error.—T. C.

Cinchonine; Hydrogenation of —. M. Freund and J. A. W. Brodenberg. Annalen, 1914, 407, 43—84. J. Chem. Soc., 1915, 108, i, 159. (See this J., 1915, 376.)

DIHYDRODESOXYCINCHONINE, m. pt. 134°—135° C., was obtained, together with an isomeric oily base, by reducing cinchonine by Tafel's electrolytic method at a lead cathode in 50% sulphuric acid at 30°—35° C., using a divided cell and a cathode density of 0.023 amp. per sq. cm. at 24 volts. It has an alkaline reaction to litmus and an intensely bitter taste, and in alcohol has $[\alpha]_D^{20} = +250^\circ$. Tetrahydrodesoxycinchonine is a viscous brown oil, which has $[\alpha]_D^{20} = +64.6^\circ$ in about 3% alcoholic solution. Dihydrodesoxycinchonine, m. pt. 72°—73° C., separates from ethyl ether in colourless crystals containing ether, m. pt. 61°—62° C. The base has $[\alpha]_D^{20} = +324^\circ$ in about 2% alcoholic solution, absorbs carbon dioxide, is alkaline to litmus, and instantly decolorises acidified potassium permanganate. In contrast to the behaviour of dihydrodesoxycinchonine, dihydrodesoxycinchonine is not oxidised to desoxycinchonine by iodine or mercuric chloride. The oily base obtained by the electrolytic reduction of cinchonine has b. pt. 295° at 18 mm., and $[\alpha]_D^{20} = +95.8^\circ$ in about 4% alcoholic solution; it has been named isodihydrodesoxycinchonine.

Morphine series of alkaloids; Action of acetic anhydride on the —. II. Study of the morphine bases in which acetic anhydride does not cause the fission of the nitrogen ring. M. Tiffeneau. Bull. Soc. Chim., 1915, 17, 109—114. (See this J., 1915, 509.)

DIACETYLMORPHINE was prepared by warming morphine hydrochloride with acetic anhydride on a water-bath for 20 hours. It melts at 173° C., and boils at 272°—274° C. at 23 mm. On further treatment with acetic anhydride for several hours at 170°—180° C., it undergoes no further change, and under these conditions, therefore, the fission of the nitrogen ring does not take place. In a similar way the hydroxyl groups of codeine, ethylmorphine, and thebaine (prepared by reduction of thebaine with stannous chloride) can be acetylated, and the acetyl derivatives, after treatment with acetic anhydride for 7—8 hours at temperatures of 170°—180° C., can be recovered unchanged, the nitrogen ring remaining intact. Acetylcodeine melts at 133° C., and boils at 258° C. at 11 mm. Acetyl-ethylmorphine melts at 131° C., and boils at 260°—262° C. at 12 mm. pressure. —G. F. M.

Morphine series of alkaloids; Action of acetic anhydride on the —. III. Apomorphine series: diacetyl- and triacetyl-apomorphine. M. Tiffeneau and Porchet. Bull. Soc. Chim., 1915, 17, 114—119.

THE acetylation of apomorphine, hitherto unsuccessfully attempted by Pschorr and others (Ber., 1902, 35, 4385), was accomplished by heating apomorphine or apomorphine hydrochloride with acetic anhydride on a water-bath for 20—30 hours. The product consisted mainly of a mixture of about equal parts of diacetyl- and triacetyl-apomorphine. The fission of the nitrogen ring in the latter substance had deprived it of basic properties, and it was separated from the basic diacetyl-derivative by taking advantage of this fact. Diacetyl-apomorphine crystallised from a mixture of ethyl acetate and petroleum spirit in needles, m. pt.

129° C.; with an aqueous solution of its hydrochloride $n_D = -67.26^\circ$. Its salts possess the same physiological action as those of apomorphine and have the advantage of being stable in solution. With methyl iodide diacetyl apomorphine gives a methiodide, m. pt. 233° C. Triacetyl apomorphine melts at 137° C., is optically inactive, insoluble in water and acids, and does not possess the emetic properties of the diacetyl-derivative. During the investigation a crystalline apomorphine, free from solvent of crystallisation, was obtained by crystallising from a mixture of chloroform and petroleum spirit. It forms hexagonal lamellae, m. pt. 195° C. —G. F. M.

Cicutoxin: the poisonous principle in water hemlock (Cicuta). C. A. Jacobson. J. Amer. Chem. Soc., 1915, 37, 916–934.

CICUTOXIN, $C_{15}H_{24}O_3$, which occurs in the root-stalk of the various species of the water hemlock (*Cicuta*), is extracted from the pulped tubers with ether at the ordinary temperature. It is a viscous, yellowish, liquid resin which readily decomposes and polymerises, especially when warmed. It combines violently with free bromine, yields a diacetyl derivative, also lead and barium derivatives, and combines with hydrochloric acid and with ammonia. The substance appears to be a complex pyrone derivative. It is a spasmotoxin, causing death in from thirty minutes to eight hours; the treatment consists in producing vomiting and administering a narcotic. In testing for cicutoxin 2% baryta water is added to the 5% alcoholic solution until a voluminous precipitate appears and the colour changes to light green; upon adding a few more drops of baryta water and allowing to stand, a pea-green to olive-green colour is attained in from one to ten minutes. This changes to a reddish brown if an excess of baryta water has been added, and to dark red on addition of a slight excess of a mineral acid. —J. R.

Anæsthesia by phenylethylmalonylurea. W. L. Symes. J. Physiol., 1915, 49, 126–132. J. Chem. Soc., 1915, 108, i, 191.

PHENYLETHYLMALONYLUREA ("luminal") causes anæsthesia in cats when a dose of 0.2 gm. is injected under the skin; the anæsthesia is usually complete in an hour, and lasts three to five hours. Smaller doses administered subcutaneously or by the mouth act more slowly. Under the influence of the drug, the cat becomes poikilothermic. Cats may with care be kept unconscious for days, and then make a complete recovery; in rabbits intravenous injection may be used; anæsthesia is then rapidly produced.

Lime and lemon as sources of citric acid and essential oils; Notes on the — W. R. Dunlop. Bull. Imp. Inst., 1915, 13, 66–87.

THE lime contains more juice and citric acid but less essential oil than the lemon: the yields per acre are about 914 lb. of citric acid and 65 lb. of oil for the lime, and 434 lb. of acid and 88 lb. of oil for the lemon. The cost of cultivation of the lemon in Sicily is higher, owing to the necessity for irrigation and protection against frost. The production of lemons in Sicily is stationary, but the proportion treated for the production of calcium citrate varies according to the demand. The future development of the industry of citrus products depends almost entirely upon the extension of lime cultivation, which is especially well adapted to the West Indies and Central America. The output of lime products in the tropics is small at present but is rapidly increasing. The calcium citrate exported from the West Indies is of satisfactory quality, but the raw lime juice varies considerably and frequently contains an excessive quantity of sediment. The exports of lime

products from the British West Indies in 1913–1914 amounted to: Dominica, £142,662; Montserrat, £5977; Jamaica (average of last four years), £1179; St. Lucia, £3108; British Guiana, £1530; total £157,456. The author recommends also the cultivation of oranges in the West Indies for the production of essential oils. —A. S.

Arsenic compounds; Aromatic — VIII. Some products of the reduction of 2,4-dinitrophenyl-arsinic acid, and a large class of new derivatives of carbaminic acids. P. Karrer. Ber., 1914, 47, 2275–2283. Bull. Soc. Chim., 1915, 18, 155–156.

2,4-DINITROPHENYLARSENOXIDE, a feebly basic substance, was obtained by the action of phosphorus trichloride on an ethereal solution of dinitrophenylarsinic acid. 2,4,2',4'-Tetranitroarsenobenzene was prepared by reducing dinitrophenylarsinic acid with hypophosphorous acid in presence of sodium hydroxide, and a small quantity of potassium iodide as catalyst. The reaction proceeded at 50°–60° C., and the product was deposited in brownish-yellow flakes, insoluble in all solvents. Reduced with stannous chloride it gave the corresponding tetra-amino-derivative, which is readily hydrolysed at ordinary temperature to *m*-phenylenediamine and oxides of arsenic. It can be combined with diazo compounds, giving azo-colouring matters. This, and other *m*-diamines whether containing arsenic or not, are characterised by dissolving in excess of sodium carbonate or sodium bicarbonate with the production of carbaminic acid derivatives. This solubility in sodium carbonate or bicarbonate solutions may be used as a test for *m*-phenylenediamines. —G. F. M.

4,4'-Diphenylsemicarbazide as a reagent for the detection of carbonyl derivatives. B. Toschi and A. Angiolani. Gaz. Chim. Ital., 1915, 45, I, 205–213.

4,4'-DIPHENYLSEMICARBAZIDE, obtained in almost quantitative yield by mixing alcoholic solutions of equivalent quantities of diphenylurea chloride and hydrazine hydrate (see Gaz. Chim. Ital., 1914, 44, I, 443), forms an excellent reagent for identifying compounds containing the carbonyl group. It possesses the advantages over semicarbazide that it does not decompose on exposure to air and light and that the diphenylsemicarbazones are less soluble than the corresponding semicarbazones. It reacts readily even with acetone, salicylaldehyde, benzophenone, and certain sugars which react only slowly with semicarbazide. In the case of aliphatic carbonyl derivatives it is preferable to use the hydrochloride of diphenylsemicarbazide; with aromatic compounds the free base is used. The diphenylsemicarbazones of the following compounds are described: acetone, colourless needles, m. pt. 119° C.; acetaldehyde, silky needles, m. pt. 153° C.; cinnanol, colourless needles, m. pt. 133°–134° C.; ethyl acetoacetate, m. pt. 103°–104° C.; dextrose, white needles containing 1 mol. H_2O , m. pt. 164°–166° C.; cinnamic aldehyde, yellow needles, m. pt. 164°–166° C.; cinnic aldehyde, m. pt. 162° C.; salicylaldehyde, colourless needles, m. pt. 209° C.; vanillin, white needles, m. pt. 180°–181° C.; piperonal, yellow needles, m. pt. 173° C.; benzophenone, white needles, m. pt. 186°–187° C.; citronellal, white crystals, m. pt. 109°–110° C.; camphor, silky needles, m. pt. 154°–155° C. —A. S.

a-Diketones (diacetyl, etc.); Separation and identification of certain homologues — J. M. Johlin. J. Amer. Chem. Soc., 1915, 37, 892–896.

DIACETYL and probably other homologous diketones are produced in the destructive distillation of wood and of carbohydrates. Diacetyl occurs in considerable quantities in pyrolysine acid. On

part of diacetyl in 100,000 parts of water gives a recognisable precipitate of the nickel salt of dimethylglyoxime upon the addition of a little nickel chloride, hydroxylamine hydrochloride, and ammonia; the precipitation is rendered quantitative by adding sodium acetate also. The salt is practically insoluble in both cold and hot water. From a mixture containing 0.1 gm. of each of the nickel salts of methylglyoxime, dimethylglyoxime, and methylethylglyoxime, the last-named may be extracted with ether; the extract is shaken with 5% sulphuric acid and evaporated to dryness, and the residue when crystallised from water yields pure methylethylglyoxime, m. pt. 171° C. The residue from the ether extraction is extracted with dilute ammonia, and the undissolved portion shaken with ether and 5% sulphuric acid; the ethereal layer is evaporated to dryness, and the residue recrystallised from water, whereby pure dimethylglyoxime, m. pt. 234°–235° C., is obtained. The ammonia extract is likewise treated with 5% sulphuric acid and ether; the residue from the evaporation of the ether extract is dissolved in water containing a trace of ammonia and a few drops of nickel chloride added to precipitate dimethylglyoxime; methylglyoxime is extracted with ether from the filtrate, and after resublimation melts at 155°–156° C.—J. R.

Glucometahydroxycoumarin and glucoprotocatechuic acid; Synthesis of ——. F. Maithner. J. prakt. Chem., 1915, 81, 174–179.

TETRA-ACETYLGLUCOMETAHYDROXYCOUMARIN is produced by the interaction of *m*-hydroxycoumarin and acetobromoglucose in presence of dilute sodium hydroxide and acetone at the ordinary temperature; it is slowly hydrolysed in the cold by dilute baryta water, yielding glucometahydroxycoumarin (m. pt. 219°–220° C.). When *m*-hydroxycoumarin is replaced by the methyl ester of protocatechuic acid the reaction yields the ester of tetra-acetylglucoprotocatechuic acid; this is slowly hydrolysed at 37.5° C. by dilute baryta water, yielding glucoprotocatechuic acid which crystallises in colourless needles, m. pt. 81°–82° C. This acid gives no precipitate with normal lead acetate or freshly prepared gelatin solution; it yields a yellow colour with ferric chloride and an opalescence with basic lead acetate; the alkaline solution does not reduce Fehling's solution upon gentle warming.—J. R.

Phenols and phenolic ethers with unsaturated side chains; Behaviour of — towards ozone. C. Harries and R. Haarmann. Ber., 1915, 48, 32–41. J. Chem. Soc., 1915, 108, i, 133–134.

THE earlier results obtained in the formation and fission of the ozonides of unsaturated phenols such as eugenol were not entirely satisfactory (compare Harries and Weiss, J. Chem. Soc., 1904, 86, 861), because under the usual conditions the normal course of the changes was considerably disturbed by complications. The problem has therefore been re-examined in the case of the substances detailed below, of which it was found generally possible to prepare the ozonides by treatment of a solution with well-dried 1% ozone. In hexane solution isoeugenol gave a yellow, syrupy ozonide, $C_{12}H_{14}O_5$, which, when produced in acetic acid solution, underwent decomposition, giving acetaldehyde and a 25–38% yield of vanillin, together with resinous substances. It was found that mere treatment of an acetic acid solution of isoeugenol with a current of oxygen for 120 hours also effects partial oxidation to vanillin, this substance being produced to the extent of approximately 12%. By reducing isoeugenol ozonide in ethereal solution by means of zinc dust and acetic acid (compare Harries, J. Chem. Soc., 1905, 88, i, 225; 1906, 90, i, 803), vanillin could be obtained to the extent

of 71% of the theoretical yield. Isoeugenyl acetate is remarkable in combining with more than the expected proportion of ozone, the ozonide produced in ethyl acetate solution being a crystalline solid of the composition, $C_{12}H_{14}O_5$. On fission with acetic acid, this ozonide gives rise to acetylvanillic acid in poor yield. Eugenol ozonide, obtained by the action of 1% ozone on a solution of eugenol in ethyl acetate, is an oily substance which is considerably more explosive than isoeugenol ozonide. When decomposed by warming with acetic acid, no formation of homovanillin is observable, the only product being a brown oil, b. pt. 120°–200° C. at 0.5 mm., which rapidly resinifies. Reduction of eugenol ozonide in ethereal solution by means of zinc dust and acetic acid caused fission with formation of homovanillin, $CH_3O.C_6H_4(OH).CH_2.CHO$, a colourless, viscous oil, b. pt. 110°–114° C. at 0.45 mm., with a smell resembling vanilla; *p*-nitrophenylhydrazones, deep yellow needles, m. pt. 150°; semicarbazones, prisms, m. pt. 173°; oxime, leaflets or needles, m. pt. 115°; bisulphite compound, colourless powder. Eugenyl acetate, in contrast to isoeugenyl acetate, forms a normal ozonide, $C_{12}H_{14}O_5$, which is conveniently obtained by the action of 1% ozone on a solution in hexane; the ozonide separates from ethereal solution in colourless tablets or needles, m. pt. 63° C. Fission of the ozonide by acetic acid produces acetylhomovanillic acid, acetylhomovanillin, and vanillin.

Eugenol methyl ether ozonide (Majima, J. Chem. Soc., 1909, 96, i, 945), on fission by acetic acid, gave methylvanillin. Reduction of the ozonide yielded a yellow liquid, b. pt. 112°–113° C. at 0.6 mm., of which a preliminary examination indicated it to be methylhomovanillin (*p*-nitrophenylhydrazones, m. pt. 157°; semicarbazones, m. pt. 181°).

The above results provide an explanation for the contradictory results of earlier investigators, who have found it possible to obtain vanillin from isoeugenol, using oxygen relatively poor in ozone, whilst later investigators with more effective ozone apparatus at their disposal applied too concentrated ozone and obtained only resinous products.

Vanillin; Reactions of ——. E. P. Häussler. Z. anal. Chem., 1915, 54, 104. J. Chem. Soc., 1915, 108, ii, 191. (Compare this J., 1914, 612.)

WHEN pepsin is mixed with dilute alcohol and a small quantity of vanillin, and the mixture evaporated, a yellow coloration is obtained; this changes to brownish-violet and then to brownish-red on the addition of 10% hydrochloric acid. Concentrated hydrochloric acid changes the yellow colour to violet, and the mixture becomes black on evaporation. The pepsin employed yielded a brown coloration, but no trace of violet, when treated with hydrochloric acid in the absence of vanillin; it also gave a slight biuret reaction. It has not been ascertained whether the reaction with vanillin was due to the pepsin itself or to the presence of proteins in the same.

Racemic acid; Conversion of — into a mixture of racemic acid and *D*-tartaric acid by means of *L*-malic acid. A. McKenzie. Chem. Soc. Trans., 1915, 107, 440–443.

RACEMIC acid (1 mol.) was neutralised with aqueous potassium hydroxide and *L*-malic acid (1 mol.) added. A dextro-rotatory crystalline product separated which consisted of a mixture of potassium hydrogen tartrate and potassium hydrogen *D*-tartrate, affording an example of the activation of an inactive compound by crystallisation from an optically active solvent, viz., a solution of *L*-malic acid.—T. C.

Ether; Oxidation of—R. M. Isham and C. E. Vail. *J. Amer. Chem. Soc.*, 1915, 37, 902—906.

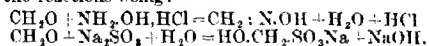
WHEN mixed with air or oxygen, ether vapour oxidises slowly at 110° C. and rapidly at 160° C. to acetaldehyde and acetic acid. Chromic anhydride does not dissolve unchanged in pure ether, as sometimes stated, but even at -10° C. a violent reaction occurs resulting in the formation of acetaldehyde and chromic oxide.—J. R.

Formaldehyde reactions. E. Salkowski. *Biochem. Zeits.*, 1915, 63, 337—346. *J. Chem. Soc.*, 1915, 108, ii, 190.

THE reaction of Leach is sensitive, but it fails in the presence of relatively large amounts of acetaldehyde. ω -Hydroxymethylfurfuraldehyde also gives a positive result with Leach's reagents. This substance also gives a coloration in the reactions of Rimini (this J., 1898, 697, 1076) and of Schryver (this J., 1909, 956), but the shade of colour produced is not exactly that formed by formaldehyde, and is not obtained in dilute solutions, so that the two substances are not likely to be mistaken for one another. Bono's reaction for formaldehyde (this J., 1912, 1048) cannot be used in the presence of ω -hydroxymethylfurfuraldehyde. Least influenced by this substance is Rimini's reaction, both in its original form and when hydrogen peroxide is used instead of ferric chloride; it is less sensitive, however, than Schryver's reaction. As ω -hydroxymethylfurfuraldehyde is always formed by the action of acids on carbohydrates, it must always be sought for in certain cases when the existence of formaldehyde is investigated.

Formaldehyde and methyl alcohol in aqueous solutions; Determination of—[Analysis of formatin.] G. Lockemann and F. Croner. *Z. anal. Chem.*, 1915, 54, 11—26. *J. Chem. Soc.*, 1915, 108, ii, 190.

IN solutions containing formaldehyde and methyl alcohol, the former may be estimated by titrating the free acid or alkali formed when the solution is treated with hydroxylamine hydrochloride or sodium sulphite, respectively, the equations showing the reactions being:



Methyl alcohol and formaldehyde are then estimated together by oxidation with potassium permanganate, as described by Hetper (this J., 1913, 103).

Methyl alcohol in aqueous solution; Determination of—by means of Denigès' reaction. T. von Fellenberg. *Trav. Chim. Aliment. et d'Hygiene (Swiss)*, 1915, 1. *Ann. Falsif.*, 1915, 8, 101. (See this J., 1910, 585.)

AQUEOUS solutions containing very small quantities of methyl alcohol are concentrated by repeated distillation, each distillate representing 50—60% of the liquid distilled; and volatile acids, bases, or aldehydes, etc., are removed by treating the distillates with caustic soda, sulphuric acid, or silver nitrate. Three c.c. of the final distillate is shaken in a wide test tube with 1 c.c. of an aqueous solution containing 10 c.c. of ethyl alcohol and 20 c.c. of concentrated sulphuric acid per 100 c.c., and with 1 c.c. of a 5% solution of potassium permanganate, and then left to stand for 2 mins. At the same time two parallel tests are carried out in the same way with 3 c.c. of water containing 0.005 and 0.001 grm. of methyl alcohol, to serve as standards. After the 2 mins., 1 c.c. of 8% oxalic acid solution is added to each tube, and after a few seconds 1 c.c. of concentrated sulphuric acid, followed immediately by 5 c.c. of a solution containing 5 grms. of magenta, 12 grms. of sodium sulphite, and 100 c.c. of N/1

sulphuric acid per litre. The liquid in the first tube is then diluted with 25 or 100 c.c. of water and compared in a colorimeter with one or other of the standard tests diluted to the same extent, and the quantity of methyl alcohol found by reference to tables.—J. H. L.

Acetylene; Progressive reduction of—Catalytic actions of colloidal metals of the platinum group. XII. C. Paal and C. Hohenegger. *Ber.*, 1915, 48, 275—287. *J. Chem. Soc.*, 1915, 108, i, 113—114.

NUMEROUS experiments were made on the reduction of acetylene by hydrogen in presence of colloidal palladium, partly in a gas burette, partly in a vessel which could be shaken, and partly in an apparatus in which the gases could be circulated. The chief result was the demonstration of the influence of the adsorption of acetylene by palladium on the course of the reaction. Starting with equal volumes of acetylene and hydrogen, and with a fresh palladium solution, so much of the former gas was adsorbed by the colloid and chemically changed, in all probability polymerised (this J., 1913, 186), that the hydrogen was really in effective excess, with the result that varying volumes of ethane were formed and some acetylene remained unchanged. This is probably the reason why in previous investigations on the catalytic reduction of acetylene the chief product was always ethane, even when insufficient hydrogen to complete the first stage—reduction to ethylene—was employed. When the colloid has been in contact with acetylene, it loses the power of adsorbing the gas and the yield of ethylene increases. Indeed, with a slight excess of acetylene, all the hydrogen may be used in the formation of ethylene.

The mixtures of gases were analysed as follows. The two unsaturated hydrocarbons were absorbed by bromine water and the acetylene estimated separately by an approximate method (Hohenegger, *Diss.*, Erlangen, 1912) in which an ammoniacal silver solution was used as the absorbent. Hydrogen was estimated in the residue by absorption with palladium hydrosol and sodium picrate (this J., 1910, 236), and the ethane (and impurities) measured by difference. (See also Karo, *Ger. Pat.* 253,100; this J., 1913, 109.)

Chlorides of carbon; Action of metals on the—E. V. Zappl. *An. Soc. Quim. Argentina*, 1914, 2, 217—228. *J. Chem. Soc.*, 1915, 108, i, 114.

A STUDY of the interaction, at ordinary and elevated temperatures, of aluminium, magnesium, iron, sodium, and silicon respectively, and carbon tetrachloride, hexachloroethane, hexachlorobenzene, and octachloronaphthalene. At 180° C., aluminium decomposes carbon tetrachloride, liberating carbon, and forming hexachloroethane and aluminium chloride. Under other conditions, aluminium has no action on any of the substances named, or only a very slight effect. The other metals either do not react at all, or only to a very limited degree.

Magnesium citrate; Official—E. Léger. *J. Pharm. Chim.*, 1915, 11, 157—166.

THE conditions for obtaining a soluble trimagnesium citrate are:—(1) To mix the constituents in the cold; (2) to dry the mass at not above 50° C.; and (3) to use only sufficient water to give complete admixture. The most suitable proportions are:—Citric acid, 100; sifted magnesium bicarbonate, 60; and water, 35 grms. After drying for 2 to 3 hours in an oven at 45° to 50° C. the mass is pulverised. At higher temperatures insoluble magnesium citrate is formed. Crystals separating from the solution of the official citrate had the composition, $(\text{C}_6\text{H}_5\text{O}_7)_2\text{Mg}_3 \cdot 13\text{H}_2\text{O}$. The amount of magnesium oxide left by 1 grm. of

official magnesium citrate on ignition is 0.16 to 0.17 gm. instead of 0.15 gm., as prescribed by the French codex.—C. A. M.

Reduction of arylsulphonamides by hydriodic acid. Fischer. See III.

Simultaneous determination of carbon, hydrogen, and mercury in organic mercury compounds. Abellmann. See XXIII.

Velocity of formation and solution, and the swelling, of jellies. Traube and Köhler. See XXIV.

PATENTS.

Alcohols; Manufacture of—B. S. Lacy, Seward, N.J., U.S.A. Eng. Pat. 20,550, Oct. 5, 1914. Under Int. Conv., Oct. 4, 1913.

ALCOHOLS are produced by bringing alkyl halides into intimate contact with alkaline solutions at a pressure considerably above that of the vapour of the basic solution alone, and at a temperature considerably above 100° C. The rapidity of the reaction varies, *ceteris paribus*, in proportion to the difference between the working pressure and the vapour pressure of the alkaline solution. *Example:* An iron vessel of 9 litres capacity, furnished with stirring gear, is half filled with milk of lime, containing 15% by weight of calcium hydroxide, and kept at 100° C. (=107 lb. pressure). Methyl chloride is passed in until the pressure reaches 263 lb., and this pressure is maintained by regulating the supply of methyl chloride. After 15 minutes, the solution in the vessel contains 7% of methyl alcohol, which may be removed by distillation.—F. Sp.

Halides of methyl and ethyl; Production of—Actienges. für Anilinfabr. Ger. Pat. 280,740, Aug. 9, 1913.

METHYL or ethyl alcohol is heated with an aqueous solution of a hydrohalogen acid and the corresponding calcium halide in an open vessel at a temperature not above 100° C. A good yield of ethyl chloride is obtained by warming ethyl alcohol and aqueous hydrochloric acid (19° B., sp. gr. 1.152) in presence of anhydrous calcium chloride. An alternative method is to allow a mixture of methyl or ethyl alcohol and hydrochloric acid to flow continuously into a vessel containing heated calcium chloride.—A. S.

Menthylsalicylic methyl ester; Method of manufacture of—G. Blieberger, New York. U.S. Pat. 1,133,832, March 30, 1915. Date of appl. March 28, 1914.

MENTHYSALICYLIC methyl ester is made by the direct interaction of menthol and a relatively large excess of salicylic methyl ester under the influence of heat. *Example:* 100 parts of salicylic methyl ester is heated with 80 parts of menthol in an inert atmosphere under slight pressure. The first distillate is collected separately, and the residue distilled *in vacuo*.—F. Sp.

Quinolylketones; Preparation of—Verein. Chinifabr. Zimmer and Co. Ger. Pat. 280,970, Aug. 23, 1913. Addition to Ger. Pat. 268,830 (this J., 1914, 277).

ESTERS of quinolylacetic acids or their nuclear substitution products are alkylated, and the resulting β -ketone-acid esters, alkylated in the side chain, are converted into ketones in the usual way to obtain alkyl homologues of quinolylmethylketones or their nuclear substitution products.—A. S.

Propylene from acetylene and methane; Process of producing—A. Heinemann, London. U.S. Pat. 1,134,677, April 6, 1915. Date of appl. May 27, 1913.

SEE Fr. Pat. 458,397 of 1913; this J., 1913, 1086.

Anhydrides of monobasic organic carboxy-acids; Process for the manufacture of—A. J. van Peski, Vlaardingen, Netherlands. U.S. Pat. 1,136,630, April 20, 1915. Date of appl. July 30, 1913.

SEE Fr. Pat. 461,540 of 1913; this J., 1914, 219.

Halides of methyl and ethyl; Production of—Actienges. f. Anilinfabr. Fr. Pat. 172,770, May 28, 1914. Under Int. Conv., Aug. 8, 1913.

SEE Ger. Pat. 280,740; preceding.

Process for effecting reduction of fatty or other organic compounds. U.S. Pat. 1,131,746, See XII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Selective absorption; A characteristic of—A. J. Bull and A. C. Jolly. Phot. J., 1915, 55, 134—140.

THE selective absorptions of a number of substances were determined by means of the Hüfner spectrophotometer. The curves are given of some of these—chromates, iron salts, iodine, picric acid, etc. Results obtained with photographic tri-colour filters and tri-colour inks showed, especially in the case of blue inks, wide divergence of the colour from what it is theoretically desirable to obtain; the divergence is so wide as to suggest the impossibility of obtaining either filters or inks of anything approaching the theoretically desirable colours. A high transmission of one part of the spectrum appears to be accompanied by complete absorption of another part only when the latter is of shorter wave-length than the former. The selective absorptions of a number of the same substances were also examined by the aid of a line thermopile, and in general the results confirmed those obtained by the spectrophotometer.—B. V. S.

Photogravure; Machine—R. B. Fishenden, Phot. J., 1915, 55, 143—176.

FOLLOWING a short historical sketch of photogravure and a comparison of its effects with those of similar processes, a brief description is given of the methods and special appliances now generally used in producing the engraved cylinder and of the printing machinery. There are numerous illustrations and diagrams. In two appendices is given an account of the author's work on certain parts of the process. The best sensitiser for the carbon tissue is potassium bichromate solution: the ammonium salt gives more sensitiveness but poor keeping quality; the double ammonium potassium salt gives low sensitiveness. The best strength for the solution is dependent on the light used for printing, but is generally 5 per cent. In order to obtain uniform porosity of the resist it should be dried, after development, in slightly moist air at not above 21° C. An artificial illuminant is necessary to obtain constant results; comparison of mercury vapour and open, enclosed, and flame arc lamps as to efficiency, quality of print, and amount of heat radiated, showed that, on the whole, the flame arc, working at 110 volts, gave the best results. The use of a vacuum printing frame is recommended, as the thick plate glass used in the ordinary process pressure frame necessitates an increase of exposure which may reach 100%. The etching solution of ferric chloride is usually first treated with ammonia; treatment with metallic copper or cuprous chloride gives similar results; there is no difference in the results obtained with ordinary and with extra pure ferric chloride. The condition of a used etching bath is best ascertained by comparison with a specially made bath of known action. The effect of variation of strength of the etching

bath and of temperature was examined both as to the amount of erosion produced in a given time and as to the time taken to penetrate a certain resist. The rate of erosion increases with increase of strength, especially above 39° B. (sp. gr. 1.37). The rate of erosion increases also with increase of temperature, and the penetration time decreases; to obtain uniform action the temperature should not be below 17° C., and should be under control. The effect of varying the humidity of the atmosphere was also examined. A resist, between development and etching, ages more rapidly in dry air. An increase of moisture in the air up to 82% decreases the penetration time of the resist; above this there is an increase.—B. V. S.

Kinetics of photochemical reactions. Berthelot. See XXIV.

XXII.—EXPLOSIVES; MATCHES.

Cellulose; Nitration of— and the decomposition of nitrocellulose by acids and alkalis. G. Meissner. Z. ges. Schiess- u. Sprengstoffw., 8, 252. Monit. Scient., 1915, 5, 79–85.

From various experiments with nitrocellulose, the author draws the following conclusions:—The highest degree of nitration is attained by nitrating cotton at 20° C. with a mixture of equal weights of nitric acid (sp. gr. 1.5) and sulphuric acid (sp. gr. 1.84). The percentage of nitrogen is increased by nitration *in vacuo*. Prolonging the nitration beyond two hours lessens the yield. The temperature of ignition of nitrocellulose, determined by heating slowly in an oil bath a tube containing the sample, varies from 180° to 190° C., and is 20°–25° higher than that found by dropping samples into the same tube while cooling, until explosion no longer takes place. Nitrocellulose consists of a mixture of cellulose nitrates, of which those with less nitrogen dissolve more readily in ether-alcohol, any insoluble residue containing more than 12% N. Fractional precipitation of an acetone solution of nitrocellulose by water gives precipitates differing only slightly in nitrogen content. Nitrocellulose can be boiled for a limited time with acids of limited concentration without losing weight; the limits depend on the nature of the acid and its concentration, being greater for nitric than for sulphuric acid, and less for collodion cotton than for guncotton. If these limits are exceeded, loss of weight and of nitrogen occurs. It is stated that guncotton, when boiled with nitric acid of any concentration up to 30%, leaves a residue containing not less than 11.44% N, even when the loss in weight has been 50%. Complete decomposition of nitrocellulose with 96% sulphuric acid produces nitrogen acids and oxides, sulphur dioxide, carbon dioxide, oxalic, tartaric, and fatty acids (but not formic or acetic acid). Decomposition of nitrocellulose by alkalis produces sodium nitrate and nitrite, and organic sodium salts. With baryta, some carbonate is formed. Alcoholic caustic soda (20%) produces a pasty mass soluble in water. The quantity of nitrate formed could not be estimated by the nitron method (this J., 1905, 291, 451). High results were obtained, and the author suggests that nitron combines with a molecular compound of alcohol and caustic soda, $C_2H_5OH.NaOH$. Nitroglycerin is saponified more rapidly than nitrocellulose. Sulphur dioxide passed through a suspension of nitrocellulose in hot, air-free water is partially oxidised to sulphuric acid. Nitrocellulose dissolves in phenylhydrazine with evolution of gas and formation of a gelatinous reddish-brown substance.—F. Sp.

Cellulose; Nitration of—with recovery of the acids. W. Dreger. Z. ges. Schiess- u. Sprengstoffw., 8, 325. Monit. Scient., 1915, 5, 87–88.

AN application of the principle of counter currents to the washing of nitrocellulose. Six nitrating pans are placed in a circle, and a charge of cotton is nitrated in each successively. Wash water is transferred from pan to pan in such a way that each time it meets a more recently nitrated charge. By the time it has passed through five pans, it has become moderately rich in acid, and in the sixth pan it is used as the first wash of a freshly nitrated charge, after removal of the residual acids. It is then run off and collected. The process has only been tried on a laboratory scale.—F. Sp.

Influence of the quantity and method of distribution of coal dust on its explosiveness and on the strength of the explosion. Czaplinski. See IIA.

Stability of the metal ammoniates of chlorates, bromates, and iodates. Thermal dissociation and explosion. Ephraim and Jahnsen. See VII.

PATENTS.

Safety explosives. D. J. Metcalfe, A. C. Pearcy, and Curtis's and Harvey, Ltd., London. Eng. Pat. 13,138, May 28, 1914.

SODIUM chloride (15%) and ammonium oxalate (10%) are incorporated as a safety or cooling agent in an explosive consisting essentially of ammonium nitrate and nitroglycerin.—C. A. M.

Smokeless powder containing phenanthrene; Manufacture of—. G. Spica. Fr. Pat. 473,264, June 9, 1914. Under Int. Conv., June 10, 1913.

COLLODION cotton (62 to 66%) is incorporated with phenanthrene (5 to 7%) and nitroglycerin (28 to 32%), and the mixture freed from water, compressed between cylinders at 100° to 105° C., and the sheets cut into pieces of the desired size. The product has the sp. gr. 1.60; it yields 1014 litres of gas and develops 864 calories per kilo. Its stability compared with cordite in the silvered crucible test is as 2800 to 930.—C. A. M.

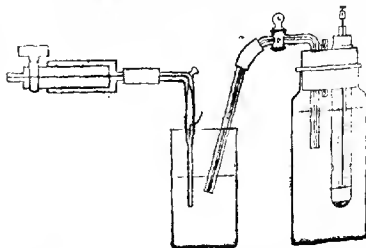
Explosives; Process for manufacturing—. C. Hartmann, Schlebusch, Assignor to Sprengstoff A.-G. Carlsberg, Hamburg, Germany. U.S. Pat. 1,135,792, April 13, 1915. Date of appl. Aug. 20, 1913.

SEE Fr. Pat. 460,571 of 1913; this J., 1914, 44.

XXIII.—ANALYTICAL PROCESSES.

Hydrogen electrode; A simple—. H. P. Barendrecht. Biochem. J., 1915, 9, 66–70.

THE electrode (see fig.) consists of a bent piece of glass tubing with a platinum wire sealed in its wall; the upper end of the tube is connected by



a piece of rubber tubing with a perforated brass or copper syringe. The point of the platinum wire is near the lower end of the tube, which is

narrowed. Hydrogen is first admitted through the tap on the syringe, while the piston is pushed home; the tap is then closed and, by drawing the piston in and out several times, equilibrium between the hydrogen and the dissolved carbon dioxide, which the liquid under examination may contain, is secured. Oxygen is removed from the liquid by drawing the latter several times up and down over the blacked wire; the oxygen is thus rapidly reduced and the liquid is then forced down the tube until its surface is near the platinum point. The other half of the galvanic cell consists of a bottle, filled with saturated potassium chloride solution, and closed with a rubber stopper through which three tubes pass. One of these is closed at the bottom, but has two openings in its side and constitutes the mercury-calomel-saturated KCl electrode; the second tube is a capillary provided with a tap and connected with a capillary filled with cotton-wool, this capillary extending into the liquid under examination; the third tube is open to the air and serves to prevent air-pressure in the bottle. —W. P. S.

Zinc; Determination of — as zinc ammonium phosphate, and its application to the separation of zinc (from other metals). P. Artmann. *Z. anal. Chem.*, 1915, 54, 89—102. *J. Chem. Soc.*, 1915, 108, ii., 181.

THE neutral zinc solution is heated to 70° C. and treated with an excess of diammonium phosphate solution, 2 grms. of ammonium chloride being also added for each 0.1 gm. of zinc present. The mixture is maintained at 70° C. for fifteen minutes, cooled, the precipitate collected, washed, and titrated iodometrically (this *J.*, 1910, 455); three atoms of iodine correspond with one atom of zinc. 100 c.c. of water at 17.5° C. dissolve 0.00145 gm. of zinc ammonium phosphate, corresponding with 0.00053 gm. of zinc, and the results are corrected for this amount, the volume of the reacting solution and the wash-water being taken into account. Zinc may be separated from copper by precipitation as zinc ammonium phosphate provided that ammonium tartrate is present in the solution; when the proportion of copper is large, a double precipitation is necessary.

Flame reactions. IV. Salts in oxygen and chlorine flames. W. D. Bancroft and H. B. Weiser. *J. Phys. Chem.*, 1915, 19, 310—330.

SALTS of lithium, potassium, and sodium give both a continuous spectrum and a line spectrum in a Bunsen flame. The introduction of hydrochloric acid into the flame retards the dissociation of the salts and reduces the intensity of the line spectrum. Blue (without yellow) luminescence is produced when sodium salts are introduced into a flame of hydrogen burning in chlorine, or by the slow combustion of sodium in oxygen, chlorine, or bromine, whilst rapid combustion produces yellow with faint blue fluorescence. The yellow fluorescence is attributed to some stage in the reaction from sodium vapour to sodium ion, and the blue to the reaction from sodium ion to undissociated sodium salt. (See also this *J.*, 1914, 570.) —C. A. M.

Copper; Colorimetric determination of —. G. Denigès and E. Simonot. *Bull. Soc. Pharm. Bordeaux*, 1914, 337. *J. Pharm. Chim.*, 1915, 11, 186—187.

Two c.c. of a solution of a cupric salt, previously treated with one-fifth of its volume of sulphuric acid, is mixed with 2 c.c. of a reagent prepared by adding 10 c.c. of sulphuric acid drop by drop to 20 c.c. of a 50% potassium bromide solution (which is meanwhile chilled in ice-water) and then separating the clear liquid from the crystalline precipitate. The coloration obtained is compared

with that given under the same conditions by a standard solution of a cupric salt. —C. A. M.

Copper and tin groups; Analysis of the —. R. Gilmour. *Chem. News*, 1915, 111, 206—208.

THE sulphides precipitated with hydrogen sulphide are boiled with 5*N* hydrochloric acid, which dissolves all except those of mercury, copper, and arsenic. Arsenic sulphide is then dissolved by treatment with sodium hydroxide solution. The chlorides in solution are treated with hydrogen peroxide to oxidise the tin, and then re-precipitated with hydrogen sulphide. Antimony and stannic sulphides are extracted from the precipitate with sodium hydroxide solution. Bismuth and lead are separated with potassium bichromate and sodium hydroxide solutions, bismuthyl bichromate being precipitated, and the lead remaining dissolved. —E. H. T.

Lead and mercury; Detection of traces of —. G. Meillère. *Ann. Chim. Analyt.*, 1915, 20, 73—77.

THE solution under examination is treated with 0.25 gm. of a copper salt (prepared from electrolytic copper) per litre, and transferred to another flask, whilst the original vessel is rinsed with 10 c.c. of hydrochloric acid for each litre of solution. The solution and washings are treated with hydrogen sulphide at first in the cold and without shaking, and subsequently with agitation on the water-bath. The precipitated copper and lead sulphides are separated in a Gooch crucible, washed, and dissolved in dilute nitric acid, the solution evaporated, and the residue ignited to decompose copper nitrate and organic matter, and dissolved in dilute nitric acid (not exceeding 1 vol. in 15). The solution is electrolysed at not above 40° C., using about 2 volts and 0.2 amp., and the lead oxide deposited on small platinum electrodes. The addition of a copper salt enables traces of lead sulphide to be detected in a liquid containing up to 2% of hydrochloric acid, which will prevent the precipitation of zinc, iron, and manganese. The same principle may be used for the separation of traces of mercury, from 0.1 to 0.2 gm. of the copper salt being added to each litre of solution. Preliminary destruction of organic matter in beer, etc., is unnecessary. —C. A. M.

Cobalt in presence of nickel; Volumetric determination of —. A. Metzl. *Z. anal. Chem.*, 1914, 53, 537—541. *Z. angew. Chem.*, 1915, 28, Ref., 77.

COBALTOUS salts are oxidised by hydrogen peroxide to higher cobalt oxides, which are converted into cobaltic hydroxide on boiling with sodium hydroxide solution. The cobaltic hydroxide dissolves in potassium iodide solution, in presence of sulphuric acid, with liberation of iodine, which may be titrated. Nickel compounds are not attacked by hydrogen peroxide. Another method of determining cobalt in presence of nickel is based on the fact that solutions of cobaltous salts, when treated with ammonium chloride and ammonia, yield complex cobalto-ammonium compounds, which can be oxidised to the corresponding cobalti-ammonium compounds, and the latter converted into cobaltic hydroxide by prolonged boiling or by means of alkali. —A. S.

Carbon monoxide; Determination of — by the iodine pentoxide method. V. Frohese. *Z. anal. Chem.*, 1915, 54, 1—11. *J. Chem. Soc.*, 1915, 108, ii., 180.

THE iodine pentoxide should be heated at 100° C during the reaction. Hydrogen is also oxidised by iodine pentoxide, iodine being liberated; at 70° the reaction with hydrogen is but slight, but at 160° C. large quantities of free iodine are

formed. The quantity of carbon monoxide present may be ascertained by estimating the carbon dioxide formed or the iodine liberated. Estimation of the carbon dioxide yields the more trustworthy results; the carbon dioxide is collected in an excess of barium hydroxide solution, and this excess is titrated, or the barium carbonate may be separated, converted into barium sulphate, and weighed as such. The gas in which the carbon monoxide is to be estimated must be freed from carbon dioxide, acetylene, and ethylene. Small quantities of carbon monoxide in air may be estimated approximately by titrating the liberated iodine, provided that air free from carbon monoxide and dioxide is passed over the heated iodine pentoxide for one hour before and after the passage of the air under examination. The quantity of carbon monoxide in a gas does not affect the method if the rate of flow of the gas through the apparatus does not exceed 1 litre per hour.

Metals; Volumetric determination of — by means of arsenic acid. J. Valentin. *Z. anal. Chem.*, 1915, 54, 76—89. *J. Chem. Soc.*, 1915, 108, ii., 180—181.

THE process consists in treating the metallic salt solution with an excess of monopotassium arsenate solution, diluting the mixture to a definite volume, and, after 24 hours, separating the insoluble arsenate by filtration, and estimating the excess of arsenate in an aliquot portion of the filtrate by adding hydrochloric acid and potassium iodide, and titrating the liberated iodine with thiosulphate solution. In the case of magnesium, calcium, strontium, barium, lead, and manganese, the precipitation with the arsenate solution is carried out in an ammoniacal solution; bismuth is precipitated in neutral solution, zinc and cadmium in the presence of sodium bicarbonate, and the mixture is then rendered neutral with acetic acid, nickel, and cobalt in the presence of sodium acetate, and aluminium and chromium in very dilute acetic acid solution.

Arsenic; Determination of — with the Marsh apparatus. O. Rind. *Oesterr. Chem.-Zeit.*, 1914, 17, 208—210. *Z. angew. Chem.*, 1915, 28, Ref., 76.

HYDROGEN arsenide from a Marsh apparatus was found to be absorbed quantitatively by soda-lime, which became almost black. On heating the soda-lime in a current of air, arsenic acid was formed and the coloration disappeared. Attempts to determine the amount of arsenic from the increase in weight of the soda-lime gave high results, and it was found that the soda-lime invariably contained zinc. It is concluded that in presence of arsenic a volatile zinc compound, probably zinc hydride, is formed in the Marsh apparatus.—A. S.

Arsenic; Determination of — by boiling a hydrochloric acid solution with hydrazine salts and potassium bromide. P. Jannasch and T. Seidel. *J. prakt. Chem.*, 1915, 81, 133—173.

AN amount of the arsenic compound corresponding to not more than 0.3 grm. As_2O_3 is washed into a litre flask with dilute hydrochloric acid; 3 grms. of hydrazine sulphate (or hydrochloride), 1 grm. of potassium bromide, and 100 c.c. of hydrochloric acid (sp. gr. 1.19) are added, and distillation is effected through a condenser and adapter into a water-cooled stoppered litre flask containing 300 c.c. of water and provided with a Pélégot exit tube which also contains a little water. The drawn-out end of the adapter is about 3 cm. above the level of the liquid. The preliminary gentle heating is followed by vigorous boiling till about 30 c.c. has distilled. Arsenic is then determined in the distillate either volumetrically by direct titration with $N/10$ potassium bromate or

gravimetrically by evaporating to a small bulk with 50 c.c. of nitric acid (sp. gr. 1.14) and adding magnesia mixture. In the former case $\text{KBrO}_3 = 3\text{As}$, and the indicator consists of a few drops of 2% methyl orange, the end-point being marked by the disappearance of the original red tint. In a series of determinations the amounts of As_2O_3 taken and found, respectively, were: 0.1004, 0.1001; 0.0998, 0.1001; 0.1002, 0.1002; 0.1003, 0.1004; 0.1002, 0.1000 grm. The hydrazine method is especially applicable to mixtures of arsenic with various metals and acids and to arsenical ores. To destroy hydrazine salts the residual liquid is freed from hydrochloric acid by evaporation on the water-bath; nitric acid is added to the cold liquid, which is finally evaporated to dryness on the water-bath; more nitric acid is added and the process repeated. Antimony or mercury may be determined directly in the residual liquid by the sulphide method without first destroying the hydrazine. Copper and silver are determined as free metal by the hydrazine method, lead as lead sulphate, bismuth with ammonia and hydrogen peroxide, cadmium with potassium carbonate, and tin with ammonia; all after first destroying the excess of hydrazine salts, in the case of tin without bringing the residue quite to dryness. Gold is determined as metal by simply rendering the undistilled liquid alkaline and warming. Phosphoric, vanadic, molybdic, and tungstic acids are determined by the usual methods after destroying the hydrazine; arsenic is only completely separated from tungstic acid after repeated distillation. In determining arsenic in ores, e.g., mispickel and proustite, the powdered ore is evaporated to dryness with *aqua regia* and then treated in the manner outlined above.—J. R.

Alkaline-earth metals and alkalis; Separation of — [in qualitative analysis]. R. Gilmour. *Chem. News*, 1915, 111, 217.

THE following procedure has given excellent results in practice: The filtrate from the iron group is evaporated to dryness and heated to expel ammonium salts; the residue is dissolved in 10 c.c. of water with a few drops of hydrochloric acid if necessary, and any carbonaceous matter filtered off. The filtrate is heated with 5 c.c. of ammonium chloride, 5 c.c. of ammonia, and 10 c.c. of ammonium carbonate solutions and filtered. The washed precipitate is dissolved in not more than 3—4 c.c. of acetic acid, the solution is neutralised with ammonia, then treated with 2 c.c. of acetic acid and diluted to 15—20 c.c., heated to boiling, treated with about 10 c.c. of potassium chromate solution, maintained nearly boiling for 2—3 mins. and filtered from barium chromate. The carbonates of calcium and strontium are reprecipitated from the filtrate by heating with 3—4 c.c. of ammonium carbonate solution in excess of the amount necessary to change the colour of the liquid from orange to yellow. The washed precipitate is dissolved in hot acetic acid, and after being made alkaline with ammonia the liquid, which should not exceed 4—5 c.c., is divided into two portions. The first is boiled for a few minutes with an equal volume of saturated calcium sulphate solution to detect strontium. The second is boiled with an equal volume of a strong solution of potassium ferricyanide; a white crystalline precipitate or turbidity appearing after a minute or two indicates calcium. The group filtrate from the alkaline-earth carbonates is concentrated to about 10 c.c. and allowed to stand for 15 mins. after addition of 4—5 c.c. of ammonium carbonate solution and 15 c.c. of alcohol, the interior of the vessel being rubbed with a glass rod to induce crystallisation if necessary. The magnesium ammonium

carbonate is filtered off and the filtrate tested for sodium and potassium.—J. H. L.

Carbon, hydrogen, and mercury in organic mercury compounds; Simultaneous determination of—A. Abelnmann. Ber., 1914, 47, 2935—2938. Z. angew. Chem., 1915, 28, Ref. 74.

The substance is burnt in a combustion apparatus, and a tube filled with spirals of fine gold wire or gold foil to retain mercury vapour is inserted between the combustion tube and the absorption vessels for water and carbon dioxide. After each determination the tube containing the gold is heated *in vacuo* to expel the mercury.—A. S.

Sugar: Cause and significance of an abnormal reaction obtained in testing urine for—with Fehling's solution. W. Cramer. Biochem. J., 1915, 9, 71—77.

A SPECIMEN of urine, containing about 1.5% of dextrose, yielded a scarlet, transparent solution when heated to boiling and mixed with an equal volume of diluted Fehling's solution; after a time, the mixture darkened, and deposited a black precipitate of extremely finely-divided metallic copper. This reduction of cupric salts to metallic copper can be brought about by concentrated aqueous solutions of reducing sugars, but it takes place more readily when the reducing sugar is present in a urine of normal concentration as regards the usual urinary constituents; it is facilitated by the fact that some of the constituents of normal urine (creatinine, urinary colloids, etc.) are capable of holding cuprous oxide in solution.—W. P. S.

Reducing sugars in urine; New test for—W. Cramer. Biochem. J., 1915, 9, 156—160.

THE test depends on the reduction of mercuric oxide in slightly alkaline solution to metallic mercury. The reagent is prepared by dissolving 0.4 gm. of mercuric oxide and 6 grms. of potassium iodide in 100 c.c. of water, and adjusting the alkalinity of the mixture, by the addition of *N*/10 acid or alkali solution, so that 10 c.c. requires exactly 2.5 c.c. of *N*/10 acid for neutralisation, using phenolphthalein as indicator. To apply the test, 3 c.c. of the reagent is heated to boiling, 0.3 c.c. of the urine is added, the solution again boiled, and, after the lapse of 30 seconds, acidified with acetic acid. Normal urine containing the usual quantity (0.1 to 0.2%) of dextrose yields a very slight turbidity; when the sugar-content increases to 0.5% a distinct turbidity is produced. The reagent may be made more sensitive by increasing its alkalinity, but the normal quantity of sugar in urine then interferes by producing a turbidity; other substances, such as creatinine, also reduce strongly alkaline mercuric oxide solutions. The acetic acid is added to dissolve precipitated phosphates.—W. P. S.

Blood; Improved haemin test for—, with notes on some recently proposed methods. W. Beam and G. A. Freak. Biochem. J., 1915, 9, 161—170.

THE following test yields reliable results when applied to blood stains, fresh or old (12 years), stains partially removed by soap and water, or heated to 160° C., or mixed with earth, or to old stains on rusty iron which has been exposed to strong sunlight and atmospheric conditions for several days. A small quantity of the suspected material is placed in a tube about 4 mm. in diameter and 35 mm. long, a few drops of acetic acid containing from 0.01 to 0.1% of sodium chloride are added, and a very fine cotton thread is inserted in the tube so that its upper end is near the top of the tube and the lower end reaches to the bottom of the liquid; the thread is made to adhere to the side of the tube by moistening it

with the liquid. The tube is maintained in a vertical position and haemin crystals usually appear near the upper half of the thread within about an hour; they gradually increase in size and may be seen with a good hand lens.—W. P. S.

Manipulation of the calorimetric bomb. Calculation of heats of combustion. Roth. See IIa.

Combustion of volatile substances in the calorimetric bomb. Roth and Wallasch. See IIa.

Separation of ethane and ethylene by fractional distillation in a vacuum at low temperatures. Burrell and Robertson. See IIa.

Penot's method of analysing hypochlorites. Clarens. See VII.

Action of ammonium salts on mercuric iodide. Guareschi. See VII.

Volumetric determination of the higher oxides of lead and manganese with titanium trichloride. Moser. See VII.

Determination of the higher lead oxides. Milbauer and Pivnicka. See VII.

Acidity of hydrogen peroxide solution. Callan. See VII.

Chemical reactions in anhydrous hydrazine. Welsh and Broderick. See VII.

Determination of platinum, palladium, and gold [in ores]. Determination of silver in ores and concentrates containing platinum and palladium. Smoot. See X.

Rapid electrolytic determination of copper [in brass]. Theel. See X.

Determination of iron disulphide (pyrites) in soil. Rodt. See XVI.

Employment of artificial light in the titration of resins in kops. Larsen. See XVIII.

Determination of total solids and nitrogen in milk. Meillère. See XIXa.

Detection and determination of saccharin in foodstuffs. Ceccherelli. See XIXa.

Determination of crude fibre. Fanto and Nikolitsch. See XIXa.

Determination of iron in water with titanium trichloride. Zink and Liere. See XIXb.

Determination of organic matter in potable water. Filippo and Backer. See XIXb.

A possible source of error in alkaloidal assays. Self. See XX.

Separation and identification of certain homologous α -diketones [diacetyl, etc.] Johnin. See XX.

Reactions of vanillin. Haussler. See XX.

Formaldehyde reactions. Salkowski. See XX.

Determination of formaldehyde and methyl alcohol in aqueous solutions. Lockemann and Croner. See XX.

Determination of methyl alcohol in aqueous solution. Von Fellenberg. See XX.

PATENTS.

Gas analysis: Quantitative—by an acoustic method. Badische Anilin und Soda Fabrik. Ger. Pat. 281,157, May 22, 1913.

SOUND waves are produced in the gaseous mixture under examination, and the tone produced is compared with a note of definite pitch produced simultaneously. The sound waves are transmitted by a microphone or telephone to a vibrating tongue or a small group of vibrating tongues which will respond only to waves of definite frequency, corresponding to a definite composition of the gaseous mixture. The vibrating tongue or tongues may be connected with an alarm or with a recording device. A whistle or pipe actuated by pure air, or a tuning fork, bell, or the like, may be used for producing the standard note for comparison. The method is less sensitive the lower the pitch of the note produced.—A. S.

Gas mixtures: Analysis of—Badische Anilin und Soda Fabrik. Ger. Pat. 281,584, Jan. 4, 1914.

Two similar vessels, sealed at their lower open ends in liquid in a common receptacle, are filled respectively with the gas under examination and with a standard gas for comparison, e.g., air. The gases are then allowed to flow out through narrow openings, as far as possible under the same pressure, until a definite quantity of the standard gas has escaped: the volume of the other gas escaping in the same time is a measure of the density and hence of the composition of the gas. The movements of the vessels as the gases are introduced and discharged may be made to control automatically the gas inlet and outlet valves and a recording device.—A. S.

Calorimetry of gaseous fuels. U.S. Pat. 1,131,768. See IIA.

XXIV.—MISCELLANEOUS ABSTRACTS.

Advisory Council on industrial research.

ON May 13th the President of the Board of Education stated that he was including in the estimates for salaries and expenses of the Board a sum of £25,000 to £30,000 for the purpose of instituting an advisory council on industrial research, which should represent the various industries of the country and work in co-operation with the Board of Trade to secure closer association of science with industry. He hoped that the advisory council would begin their work in a few weeks.

War economy and chemical industry [in Germany]. Chem.-Zeit., 1915, 39, 251.

IN Germany the control of all raw materials required in the manufacture of munitions of war is in the hands of a special department of the war office. Committees have been appointed to deal with metals, chemicals, skins, leather and tanning materials, jute, flax, linen yarn, rubber, cotton, hemp, tinplate, and organic products, and supervision has been facilitated by establishing raw-material companies, such as Kamawoll A.-G., Kriegeschemikalien A.-G., and Kriegesmetall A.-G., and clearing houses for linen yarn, flax, jute, rubber, wool, and horsehair. The resources of Belgium also are being organised and a bureau of administration for raw materials exists in Brussels. Steps have been taken to enlarge the output of ammonia, nitric acid, and calcined alumina, and great activity is reported in the production of metals, especially of refined copper, whilst the refining of zinc constitutes a new industry for Germany. Successful substitutes for aluminium, brass, and copper alloys have been found in tin-

plate, steel, and galvanised iron, respectively, and iron is being employed for making electrical conductors.—F. SOHN.

Diffusion in aqueous solution: Counter—G. S. Walpole. Biochem. J., 1915, 9, 132—137.

EXPERIMENTS described by Osborne and Jackson (Biochem. J., 1914, 8, 246), in which two solutions were placed in contact over a relatively small surface, the one vertically over the other, were repeated; the upper one was a *N*/10 potassium chloride solution and the lower one a similar solution containing also ammonium sulphate (3-mol. strength). The conclusions of Osborne and Jackson are confirmed, but additional determinations of potassium and ammonia in the two solutions suggest the following expression of the results:—After some days the ammonia diffuses into the upper liquid faster than the equivalent quantity of sulphate, with the result that the chloride concentration in the upper liquid increases, whilst the potassium concentration increases in the lower liquid.—W. P. S.

Electrical conductivity of pure liquids. J. Carvallo. Ann. Phys., 1914, [ix.], 1, 171—225; 2, 142—225. J. Chem. Soc., 1915, 108, ii., 135.

THE question as to whether liquids other than water are characterised by a definite limiting conductivity in the pure state has been investigated by experiments on sulphur dioxide, ethyl ether, ammonia, acetone, methyl alcohol, ethyl alcohol, hydrogen cyanide, and hydrogen iodide. Preliminary purification was effected by a series of fractional distillations at the ordinary pressure or in a vacuum, and in some cases further purification resulted on the prolonged passage of a continuous current through the liquid. The electrical treatment was always found to be accompanied by a diminution of the conducting power in the case of ethyl ether, aliphatic hydrocarbons, and ammonia; ethyl alcohol gave an increase, methyl alcohol no effect, and with sulphur dioxide and acetone the change was variable, and depended on the sample of liquid subjected to the action of the current. In the limiting condition reached in the case of sulphur dioxide, ammonia, ethyl ether, and the hydrocarbons, the behaviour of the liquids resembles that which is met with in gases, and suggests that these substances have no measurable characteristic conductivity in the pure state. The following values, representing the minimum observed conductivities, are recorded; in most cases these are very much smaller than the values recorded by previous observers: sulphur dioxide (15° C), 1.8×10^{-11} ; ammonia (15°), 3.8×10^{-10} , (−80°) 4.9×10^{-10} ; ethyl ether (16°), 7.6×10^{-10} ; acetone (15°), 1.2×10^{-10} ; ethyl alcohol (17°), 0.9×10^{-8} ; methyl alcohol (0—20°), 8.0×10^{-7} ; hydrogen cyanide (0°), 1.1×10^{-7} . It would appear that a limiting conductivity, which is independent of the intensity of the electric field, cannot be regarded as a criterion of a perfectly pure liquid, as suggested by Warburg. This independence has been found in liquids which were known to contain traces of impurities. Under the influence of light, sulphur dioxide decomposed in accordance with the equation $3\text{SO}_2 \rightleftharpoons \text{S} + 2\text{SO}$. The impurities which are thus introduced can only be removed by distillation in a vacuum in the dark or by the electrical method. The solutions of sulphur and sulphur trioxide are photo-electrically sensitive.

The new technical chemistry laboratories of the Imperial College of Science and Technology. Engineering, 1915, 99, 551.

THE new laboratories for chemical technology at the Imperial College of Science, South Kensington,

were opened on May 12th.* The laboratories are under the direction of Professor W. A. Bone, F.R.S., and are intended solely for post-graduate work. This post-graduate course extends over two years. In the first year students are practised in technical analyses and the like, whilst in the second year they will engage in research work properly so-called. Professor Bone has, moreover, made arrangements by which a number of selected students go annually to the Skinningrove Iron Works for a month, where they are enabled to gain experience in the conduct of coke-ovens, blast-furnaces, steel furnaces, gas-producers, etc. A temporary arrangement has also been effected with the Home Office, in virtue of which other students are annually given the opportunity of a month's work at the Eskmeals experimental station.

For the present, special attention is to be directed to the detailed study of refractory materials. Research of this class has been somewhat neglected in this country, with the result that for many purposes special firebricks have had to be imported from Germany or America. The work at the new laboratories will, however, soon put our firebrick manufacturers in possession of the requisite data for the production of refractory materials to suit all present requirements.

The new laboratories occupy two floors. On the ground floor are the laboratory for refractory materials and the general analytical laboratory. There is also here a workshop in which instrument-making is carried out, a drawing-office, and a photographic dark-room. On the second floor is a lecture theatre, a room for experiments requiring to be carried out in the dark, a private research laboratory, and a general research laboratory. The laboratory has been provided with a Mond producer fitted with ammonia-recovery plant, and with a gas-holder capable of holding 3000 cub. ft. of gas. Steam, air under pressure, gas, and electricity are laid on to each work-bench. The steam is supplied at 100 lb. pressure from boilers outside the building, but is reduced to 16 lb. before distribution. It is used for drying, distillation, and boiling. The electric current is used in part for operating heaters, but mainly for supplying power for various minor operations, such as the driving of the Simkinson filtrate-washer.

The analytical laboratory is fitted with complete plant for the investigation of solid, liquid, and gaseous fuels, whilst in the laboratory for refractory materials there is, in addition to grinding and crushing machinery, an Adie tensile-testing machine. An experimental coking plant, with which all the ordinary chemical operations pertaining to coke-oven practice can be carried out, is also installed in this room. A tar-still is another important piece of apparatus here, and the students are required to conduct the complete series of operations included in the passage from crude tar to a finished dye. Provision is made by which any one of the furnaces throughout the building can be coupled up to a recording pyrometer.

In the private research laboratory experiments on the occlusion of gas by heated metals are in progress. The plant here includes two different patterns of molecular air-pumps, by means of which very high vacua can readily be maintained for very long periods of time. Another research in progress in this laboratory has reference to the surface-combustion of gases, such as electrolytic gases, or a mixture of oxygen and carbon monoxide. A plant by which gas can be compressed at 200 atmospheres into cylinders is provided in the general research laboratory. A large furnace has just been erected in this laboratory with a view to determining the relative effects in furnace work of "regenerating" the air supply, the gas supply, or both. Coupled to this is a "Bimeter" CO₂ recorder.

This laboratory also contains an Ionides brass-melting furnace and balanced gas-governor. The latter, when supplied with air and gas at different or varying pressures, passes on a mixture of both at constant pressure and composition to the furnace. This mixture is *per se* explosive, but the designer has succeeded in entirely suppressing back-firing, the mixture not igniting till it reaches the furnace. It enters this tangentially, and whilst burning traces a helical path round the crucible. A very high fuel economy is claimed, 20 lb. of brass being melted with a consumption of but 1.4 to 1.8 cub. ft. of gas per pound.

Photochemical reactions; Kinetics of —. D. Berthelot. Comptes rend., 1915, 160, 519—522.

From kinetic, thermal, and electrical energy considerations, it is shown that the speed of the electrons emitted by a surface exposed to radiation is independent of the intensity of the incident ray, but depends on the square root of the frequency, and that in photochemical reactions the frequency plays the same role as temperature in ordinary chemical reactions. Under the influence of light the particles acquire much higher velocities than under the influence of heat; hence increase of temperature has little effect on photochemical reactions. If the temperature coefficient of a photochemical reaction be found to have a value higher than 1.40, this is due to secondary chemical reactions following the primary photochemical reaction.—B. N.

Iodine; Blue adsorption compounds of —. II. and III. Derivatives of α - and γ -pyrone. G. Barger and W. W. Starling. Chem. Soc. Trans., 1915, 107, 411—424.

In addition to starch, saponarin, apigenin, etc., a large number of synthetic substances give blue additive products with iodine, which are either mixed crystals or amorphous adsorption compounds formed as the result of residual valency. There is a qualitative connection between chemical constitution and power of adsorbing iodine, since closely related substances as dihydrocoumarins, and flavanones, not possessing a crossed conjugated double linkage, :C=C:C:, do not form blue additive compounds with iodine, whilst quinones and phthaleins, which contain this linkage, show an identical behaviour to iodine. Aryl groups exert a favourable influence on iodine adsorption: with one benzene ring adsorption occurs with $N/100$ — $N/1000$ iodine, with two benzene rings down to $N/10,000$, and with three benzene rings down to $N/100,000$ iodine. Alkyl groups, particularly the isopropyl-group, diminish the power of adsorption, whilst the introduction of hydroxyl-group in xanthone, and methoxy-groups in thioxanthone greatly increases it, but these regularities apply only within narrow limits. —G. F. M.

Jellies; Velocity of formation and solution, and the swelling, of —. I. Traube and F. Köhler. Intern. Zeits. phys.-chem. Biol., 1915, 2, 42—84. J. Chem. Soc., 1915, 108, ii., 154—155.

The authors investigated the effects of the addition of various substances on the rate at which gelatin solutions gelatinise, and also on the rate of re-solution of the gel. The formation of the gel is hindered by chloroform, ether, and other narcotics, a large number of which were tested. The solution of the gel, on the other hand, is accelerated, and when the narcotics are arranged in the order corresponding with the degree to which they hinder the formation of the gelatin gel, it is found to be practically the same order as that for the acceleration of gel solution. Non-electrolytes, such as glycerol and the sugars, which increase surface tension, accelerate gel

formation, and correspondingly inhibit gel solution. Acids in amounts of less than 0.01 mol. per litre increase the rate of gel formation. Above this concentration they exert an inhibiting action, which reaches a maximum when the solution contains 0.019 mol. of almost any acid per litre. The rate of solution of the gel is affected in exactly the reverse manner. Bases similarly inhibit formation and accelerate solution of the gel. Salts, in the case of dilute gelatin solutions, accelerate formation and inhibit solution of the gel, the extent of influence being represented by the order $\text{Ca} > \text{K} > \text{Na}$ for cations and trichloroacetate, salicylate, iodide, bromide, cyanide, nitrate, chloride, sulphate, citrate for anions, the foremost in each series exerting the strongest action. With larger concentrations of the gelatin the order becomes changed. Alkaloidal salts behave in a similar way, provided the gelatin solution is dilute. With more concentrated solutions the effect is reversed. Consequently for certain strengths of gelatin solution, pilocarpine, which has the greatest accelerating action on gel formation in dilute gelatin solutions, and atropine, which has the least, become antagonistic. Similar antagonism occurs between non-electrolytes which lower surface tension and those which raise it; between narcotics and peptone, narcotics and salts, and between various salts, particularly between a calcium and the corresponding sodium salt. The authors show that a complete analogy exists between the swelling of colloids and the formation and resolution of gels. The greater the effect of an agent on the velocity of gel solution or formation, the greater is the effect on the capacity of colloids for swelling. The concentration of acid which produces the maximum inhibiting action on gel formation is approximately that which has the greatest effect on inhibition. The authors point out the bearing of these results on the problems of narcosis, hæmolysis, chemotaxis, inflammation, mechanism of muscle contraction, production of oedema, etc.

Solid and liquid phases; Exchange of atoms between—G. von Hevesy. *Physikal. Zeits.*, 1915, 16, 52–55. *J. Chem. Soc.*, 1915, 108, ii., 156.

EXPERIMENTS are described which have enabled the author to measure the rate of molecular exchange at the surface of separation of solids and liquids. The observations were made on lead and its compounds, and measurements of small changes in the distribution of lead at the contact surface were made possible by the addition of traces of thorium-B, which is an isotope of lead, to the liquid or solid phase.

In this way, observations have been made on the molecular exchange between solid lead chloride and a saturated solution of the salt, and at the surface of contact of metallic lead and lead dioxide and solutions of lead nitrate of varying concentration. The rate of exchange at the surface of metallic lead in contact with a solution of lead nitrate containing thorium-B is of such magnitude as to suggest that the exchange is not that which corresponds with complete thermodynamic equilibrium, but is due to the action of "local currents." At some points lead passes into solution, and at others separation takes place. At the surface of contact of pure lead dioxide and a solution which contained lead nitrate (0.001N) and nitric acid (0.001N) and was saturated with "infected" lead dioxide, the rate of exchange was found to be very much smaller. In this case it is possible that the observed rate corresponds approximately with the kinetic exchange which would be found in a condition of thermodynamic equilibrium.

Oxidising and reducing enzymes; Individuality of—A. Bach. *Arch. Sci. Phys. Nat.*, 1915, [iv], 39, 59–71. *J. Chem. Soc.*, 1915, 108, i., 184.

WOKER (this J., 1914, 444) has developed the theory that the different enzyme actions—peroxydase, catalase, oxygenase, and perhydridase—are all due to the action of a single ferment having the properties of an aldehyde which acts differently according to the nature of the medium. A number of experimental facts are now brought forward to refute this hypothesis, and it is shown that each of the enzymes named has a clearly marked individuality. Neither peroxydase, catalase, nor phenolase (that is, peroxydase + oxygenase) are able to reduce ammoniacal silver oxide in the cold, nor do they show a coloration with magenta-sulphurous acid. They have not therefore aldehydic properties. When boiled catalase solution, that is, the substances which accompany catalase and constitute its reaction medium, is added to purified peroxydase, the mixture is unable to liberate oxygen from hydrogen peroxide. In like manner, the addition of boiled peroxydase solution to catalase does not accelerate the oxidising action of hydrogen peroxide. Peroxydase, together with a boiled phenolase solution, is not able to transfer molecular oxygen to oxidisable molecules. The enzyme mixture can only transfer oxygen feebly linked to peroxides to such oxidisable substances. Even in presence of the substances which accompany perhydridase in milk together with acetaldehyde, peroxydase is unable to reduce nitrates. The appropriate medium has no effect in causing the enzyme to exercise a strange property.

Agricultural and forest products of German East Africa. *Bull. Imp. Inst.*, 1915, 13, 110–134. (See also this J., 1915, 361.)

THE chief exports of chemical interest from German East Africa in 1911 and 1912 were:—

Product.	1911.	1912.
	£	£
Copad	5370	3068
Copra	92,249	78,152
Cotton, raw	66,591	105,512
Ground nuts	24,487	65,602
Hides and skins	151,759	203,368
Kapok	1151	3150
Rubber and gutta-percha (plantation) Do. (wild)	180,480	362,012
Sesame seed	38,564	59,208
Sisal hemp	20,191	26,186
Sisal hemp	226,812	367,061
Sorghum	1035	7478
Syrup and molasses	1679	380
Tanning woods and barks	4793	4992
Wax	40,848	41,452
Woods, timber, and charcoal	25,940	11,837

—A. S.

Trade Report.

Russian Customs Tariff. Board of Trade J., May 13, 1915.

A RUSSIAN Imperial Decree was promulgated on March 12th/25th, whereby the proposed changes in the Customs Tariff for imported goods (see this J., 1915, 381) at once become operative.

Books Received.

EXPLOSIVES, THEIR MANUFACTURE, PROPERTIES, TESTS AND HISTORY. By ARTHUR MARSHALL, J. and A. Churchill, 7, Great Marlborough Street, London. xvi + 605 pages. Price 24s.

THIS is an opportune moment for the appearance of a treatise on explosives, for the final decision in the great war in which the chief civilised nations are engaged will depend mainly upon the quality and quantity of the explosives available. This work differs from several of its predecessors in that the author has made a careful study of the literature of the subject and has not merely compiled both good and bad. The references to original sources of information will be found most useful by those who wish to make a more detailed study of any special branch of this very wide subject. The historical portion is brief, especially that relating to the early history of gunpowder. This is, perhaps, as well because the author quotes with approval Gibbon's summary, which is notoriously erroneous.

Mr. Marshall not only deals with the various explosives as such, but also with the properties and preparation of the materials used. Many of these materials are necessarily made in the vicinity of the explosives factory, for instance, nitric acid; but soap is only exceptionally made in connection with explosives and the sketch of the soap industry might, with advantage, be omitted. The description of the processes of manufacture of the various kinds of explosives is clear and concise and the information up to date. The same may be said of the perpetually varying methods of testing. Mr. Marshall's book is evidently the result of careful study as well as practical experience, and can be recommended to all who wish for reliable information on the subject with which it deals.—W. F. R.

REPORT OF THE DEPARTMENTAL COMMITTEE APPOINTED TO INVESTIGATE THE DANGER ATTENDANT ON THE USE OF PAINTS CONTAINING LEAD IN THE PAINTING OF BUILDINGS. (Cd. 7,382.) Wyman and Sons, Fetter Lane, London, E.C. Price 1s. 2d.

BULLETIN OF THE IMPERIAL INSTITUTE. Vol. XIII. No. 1. January—March, 1915. Price 2s. 6d.

THIS issue of the Bulletin contains the results of investigations in connection with vegetable drugs and poisonous plants, wheat from Egypt, the essential oil of Sheringmali tubers, rubber from India and Dominica, fibres from various sources, and boxwood from South Africa; also a special article on the lime and the lemon as sources of citric acid and essential oils. The general articles deal with the possibilities of sericulture in British Colonies and Dependencies, and the agricultural and forest products of German East Africa. Abstracts of several of the articles appear in this issue of the Journal.

CHEMICAL TECHNOLOGY AND ANALYSIS OF OILS, FATS, AND WAXES. Vol. III. By Dr. J. LEWKOWITSCHEW. Edited by G. H. WARBURG. Macmillan and Co., Ltd., St. Martin's Street, London, W.C. Price 20s.

THIS, the last volume of the fifth edition of Dr. Lewkowitsch's well-known work, covers 155 pages, and contains, besides two chapters, an alphabetical index of the three volumes. Chapter XV. is devoted to the technology of manufactured oils, fats, and waxes, and the technical and commercial examination of the products of the oil, fat, and wax industries. Subdivisions of the chapter deal with edible oils and fats, burning oils, illuminating oils, paint oils, lubricating oils, wool oils, emulsified

oils, hydrogenated, iodised, brominated, sulphurised, boiled, and oxidised oils, vulcanised oils, nitrated oils, sulphonated oils; the candle industry, the fatty acid industry; soap and glycerin manufacture; and the technology of waxes. Chapter XVI. deals with the technology of waste oils, fats, and waxes, and the commercial products derived therefrom.

TEXTILE COLOUR MIXING. By DAVID PATTERSON, F.R.S.E. Second Revised Edition. Scott, Greenwood and Son, 8, Broadway, Ludgate, London, E.C. 128 pp. 9 by 5½ in. Price 7s. 6d.

THE early pages of this book are devoted to a brief consideration of the theory of colour and the analysis of light, including a description of the spectroscope and its uses. Subsequent chapters deal with absorption colours, colour mixing, and primary, secondary, and tertiary colours. There are numerous illustrations, including coloured plates and pattern sheets.

THE UTILISATION OF WASTE PRODUCTS. By Dr. THEODOR KÖLLER. Translated from the second revised German edition. Scott, Greenwood and Son, 8, Broadway, Ludgate, London, E.C. 327 pages. 9 by 5½ in. Price 7s. 6d.

THE wide range of waste materials covered by this work is shown in the following list of chapter headings:—I. The waste of towns. II. Blood and slaughter-house refuse. III. Fat from waste. IV. Tannery waste. V. Leather waste. VI. Fur and feather waste. VII. Waste horn. VIII. Fish waste. IX. Mother-of-pearl waste. X. Vegetable ivory waste. XI. Waste wood. XII. Cork waste. XIII. Waste paper and bookbinders' waste. XIV. Paper and pulp works by-products. XV. Waste produced in the manufacture of parchment paper. XVI. Wool waste. XVII. Silk waste. XVIII. Waste waters of cloth factories. XIX. Cotton spinners' waste. XX. Jute waste. XXI. Utilisation of rags. XXII. Colouring matters from waste. XXIII. Residues in the manufacture of aniline dyes. XXIV. Dyers' waste waters. XXV. Waste produced in butter making. XXVI. Molasses. XXVII. Waste liquids from sugar works. XXVIII. Fruit. XXIX. Waste products of the manufacture of starch. XXX. Brewers' waste. XXXI. Wine residues. XXXII. India-rubber and caoutchouc waste. XXXIII. Amber waste. XXXIV. Utilisation of turf or peat. XXXV. Manufactured fuels. XXXVI. Illuminating gas from waste, and by-products of the manufacture of coal-gas. XXXVII. By-products in the treatment of coal-tar oils. XXXVIII. Ammonia recovery. XXXIX. Petroleum residues. XL. By-products in the manufacture of rosin oil. XLI. Soap makers' waste. XLII. Alkali waste and the recovery of soda. XLIII. Sulphur. XLIV. Salt waste. XLV. Gold and silver waste. XLVI. Platinum residues. XLVII. Iridium from goldsmiths' sweepings. XLVIII. Metal waste. XLIX. Tin plate waste. L. Calamine slimes. LI. Waste iron. LII. By-products in the manufacture of mineral waters. LIII. Infusorial earth. LIV. Meerschautm. LV. Mica waste. LVI. Slate waste. LVII. Broken porcelain, earthenware, and glass. LVIII. Utilisation of waste glass.

FIRST PRINCIPLES OF PRODUCTION. By J. TAYLOR PEDDIE, F.R.S. Longman, Green and Co., 39, Paternoster Row, London. 231 pages. 7½ by 5 in. Price 5s.

THE subject is dealt with under the following headings: The state and opportunity in industry. Tariffs, free trade, and industry. The importance of science on political economy. Finance and industry. Science and industry. The co-operation of science and industry (by S. R. Illingworth). The influence of brain-power on history and in-

dustry (by Sir Norman Lockyer, with notes by Prof. R. A. Gregory). British Imperialism. German Kultur defined. Steel industry: opportunities for Britain. The concluding chapter consists of excerpts from the lecture on the chemical industries of Germany by Professor Frankland (see this J., 1915, 307).

* New Books.

(The Roman numerals in thick type refer to the similar classification of abstracts under "Journal and Patent Literature" and in the "List of Patent Applications.")

XVI. *Trinka, Dr. R.*: Eine Studie üb. einige physikalischen Eigenschaften des Bodens. (25 S.) Lex 8°. Berlin, Verlag f. Fachliteratur. 1914. M. 1.50.

XIXA. *Richmond, H. D.*: Dairy chemistry: a practical handbook for dairy chemists and others having control of dairies. 2d. ed. rev. Phil. Lippincott. '14. 11+431 p. il. Svo. 1915. \$4.50 n.

XX. *Alessandri, P. E.*: Droghe e piante medicinali (Materia medica vegetale e animale). 2a ediz. Milano, Hoepli. 16°. fig., p. xv+778. 1915. Lire 7.50.

Finzi: I derivati organici arsenicali in rapporto alla loro azione terapeutica. Padova. 8°. p. 130. 1915. Lire 3.50.

XXIII. *Tower, O. F.*: A course of qualitative chemical analyses of inorganic substances; with explanatory notes. 3rd ed. rev. Phil., Blakiston. {c. 13+89 p. Svo. 1915. \$1 n.

XXIV. *Taylor, W. W.*: The chemistry of colloids, and some technical applications. N.Y., Longmans. 8+328 p. figs. tabs. 1915. D. \$2 n.

Rotcliffe, W. H.: Chemistry. Cr. Svo. Hodder and S. London. 1915. Part 1. pp. 274. 3s. Part 2. pp. 122. 1s. 6d.

Findlay, A.: The phase rule and its applications. 4th ed. Cr. Svo. pp. 382. Longmans. 1915. Net 6s.

Newell, L. C.: General chemistry. N.Y., Heath. c. '14. 604 p. il. diagrs. 12mo. 1915. \$1.20 n.

Meyer, E.: Storia della chimica dai tempi più remoti all'epoca moderna. Introduzione allo studio della chimica. Ediz. italiana con note dei dott. M. G. e C. Lollini e prefazione del dott. prof. I. Guareschi. Milano, Hoepli. 16°. p. xxviii, 721. 1915. Lire 7.50.

* Dissertations.

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